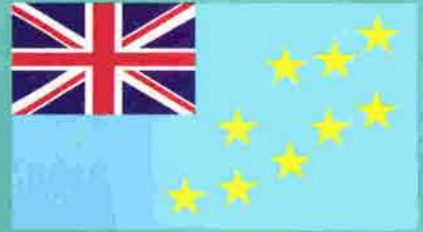


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State  
Of the  
Environment  
Report



# *Tuvalu*





# *Tuvalu*

**State  
Of the  
Environment Report  
1993**

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*Cover photograph: Traditional culture is central to Tuvaluan  
life. Part of the 'passing out' celebrations for graduating students  
of the Tuvalu Maritime School, Funafuti Atoll.  
(photo: John Lane)*



# *Tuvalu*

## **State Of the Environment Report 1993**

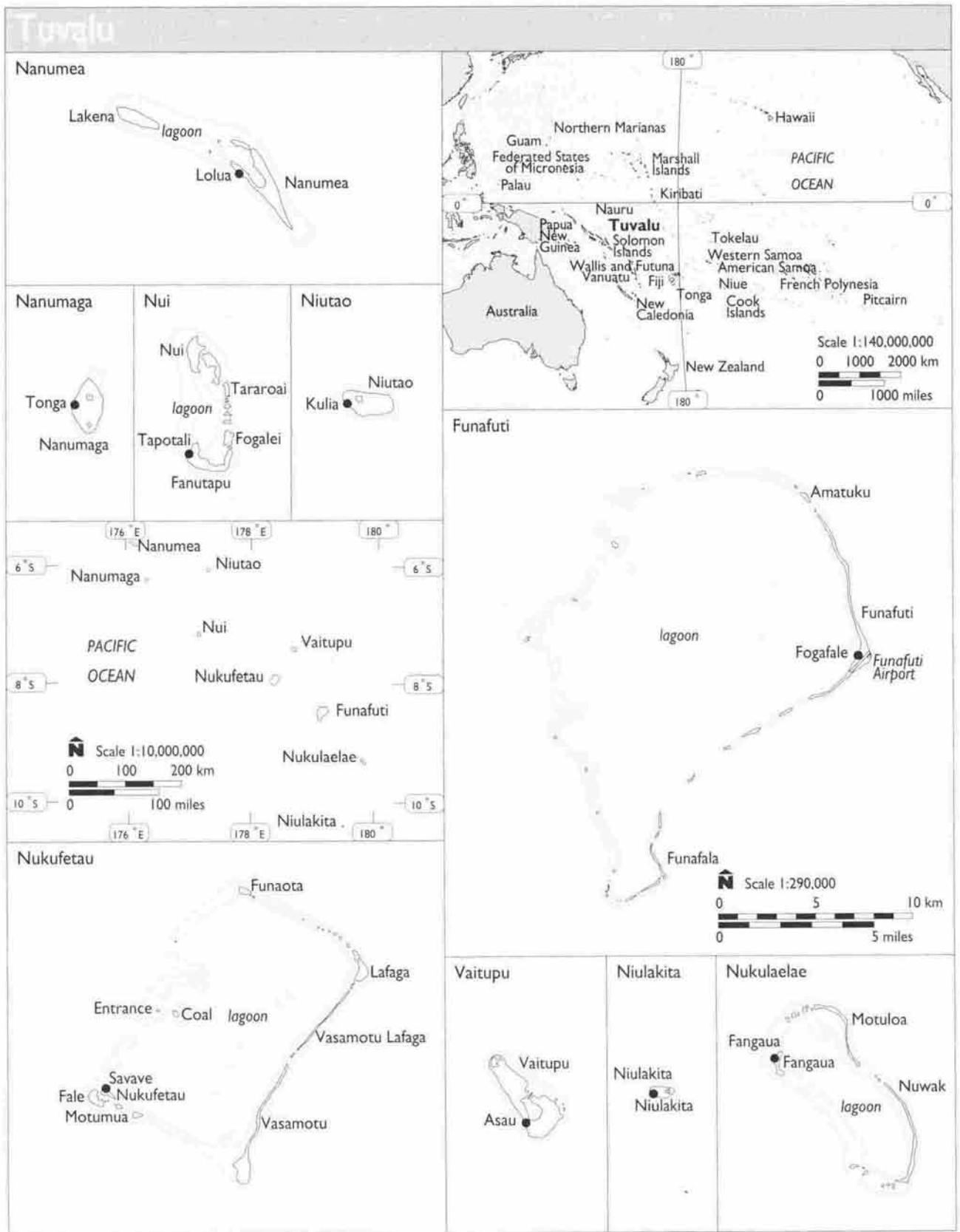
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**Prepared by John Lane**

*Report for the South Pacific Regional Environment Programme (SPREP) as documentation in support of the Tuvalu National Environmental Management Strategy (NEMS)*

**Produced with financial assistance from the  
United Nations Development Programme (UNDP)  
and the Australian International Development  
Assistance Bureau (AIDAB)**





# Foreword

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This document represents a concise report on the State of the Environment for Tuvalu. It was prepared as a major component of the National Environmental Management Strategies (NEMS) Project. The NEMS project was instigated to address sustainable environmental development and planning issues in a number of Pacific Island countries, namely, Kiribati, Nauru, Niue, Palau, Tokelau, Tuvalu and Western Samoa. It has been funded by the United Nations Development Programme (UNDP) and implemented through the South Pacific Regional Environment Programme (SPREP) as part of a broader UNDP assistance programme called Pacific Multi Island (PMI): Planning and Implementation of Pacific Regional Environment Programme which concentrates on regional and in-country institutional strengthening and training of environmental managers. In Tuvalu, the Australian International Development Assistance Bureau (AIDAB) also provided financial assistance for the NEMS process.

The State of the Environment Report for Tuvalu was a major background document for the preparation of the draft National Environmental Management Strategy (NEMS) and formed an important reference document for the National Seminar held in Tuvalu during November 1993 to refine

and develop the NEMS. The report summarises the current state of marine resources, cultural and archaeological resources, socio-economic environment, and outlines environmental challenges facing Tuvalu. The State of the Environment Report also provides an important vehicle for raising community awareness of the importance of environmental issues and how these issues should be integrated into future decision-making processes.

I would like to thank John Lane who worked with the Tuvalu Environment Officer, Alefaiio Semese, for three months during 1993 and who has prepared this State of the Environment Report.

SPREP looks forward to working with Tuvalu and other regional and international organisations in tackling the environmental issues identified in this State of the Environment Report.



Vili A. Fuavao  
*Director*  
South Pacific Regional  
Environment Programme

# Message from the Prime Minister

---

In the impetus to establish our country since we gained independence in 1978, successive governments have placed emphasis on economic and material development. Resources were employed to expand services, build infrastructure and turn from traditional subsistence activities to commercial enterprises. In this period of rapid change, the issue of maintaining our newly acquired level of development over the long term and the impact of economic growth on cultural and environmental values have not been fully addressed. In the environment sector, we are now experiencing some negative effects of the economic development model we have been following. This is particularly the case on Funafuti where much of the development and change has occurred.

I am pleased to be able to say that the government has, over the last few years, begun to change the emphasis of past policy by assigning a high priority to sustainable development and environment protection. The government is now committed to a two-tier environmental policy. The first deals with the question of climate change and possible sea-level rise induced by the actions of developed countries pursuing their own material development. Our emphasis here is to establish a high international profile and maintain a continuing debate on this issue until the developed countries take the necessary actions to reduce greenhouse gas emissions.

The second tier of our policy is to look at Tuvalu's domestic environment and introduce programmes that will overcome existing problems and ensure that we do not create new ones as economic development continues. The first stage of this work will involve the preparation of a National Environmental Management Strategy (NEMS) which will identify the main tasks to be done and the priority in which they should be addressed. The NEMS will

be an opportunity to integrate our economic development planning and policies with our environmental management programme. The government will also be using the NEMS as a basis for discussions with development partners in order to allocate funding to priority environment management projects.

This State of the Environment Report is an important step in the development of the NEMS. It is a welcome collation of the large amount of information about our environment that has been collected over many years. Unfortunately, this information has become dispersed and inaccessible, and has therefore not been used to our advantage in past development planning work. The report also identifies some significant gaps in our knowledge that we should aim to fill in the short term.

The scheduled NEMS national conference will provide an opportunity for government officers, business managers and community leaders to use this information as well as their own ideas and insights to formulate a national strategy. The government looks forward with anticipation to receiving the advice of the conference.

I would like to acknowledge and thank the South Pacific Regional Environment Programme for their valuable role. Without their support the NEMS programme would not have been possible.



The Rt. Hon. Bikenibeu Paeniu  
*Prime Minister of Tuvalu*

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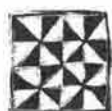
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# Acronyms

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EEZ	Exclusive Economic Zone
EIA	Environment Impact Assessment
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
IPCC	Intergovernmental Panel on Climate Change
NAFICOT	National Fishing Corporation of Tuvalu
NEMS	National Environmental Management Strategy
PWD	Public Works Department, Government of Tuvalu
SOE	State of the Environment Report
SPC	South Pacific Commission
SPREP	South Pacific Regional Environment Programme
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
USP	University of the South Pacific

# Glossary

---

## **Tuvaluan terms**

<b>'Bebe' bank</b>	Rock bank thrown up by cyclone.
<b>borrow pit</b>	Pit excavated during World War II to provide landfill for the airstrip.
<b>'pulaka' pit</b>	Pit in which taro is grown when soil conditions are harsh.

## **General**

<b>algae</b>	Non-flowering, stemless water-plant, especially seaweed and phytoplankton.
<b>artisan</b>	Someone skilled in an industrial or applied art; a craftsperson. Adj. <b>artisanal</b> .
<b>avifauna</b>	Birds of a region or country collectively.
<b>biodiversity</b>	The variety of plants and animals in an area. Biodiversity refers not only to the number of different species but to the full range of genetic variation within each species.
<b>cadastral</b>	Relating to the official register of land which shows details of ownership, boundaries and value for taxation purposes.
<b>corporatisation</b>	Process whereby an activity or enterprise previously operated and owned by government under public funding progressively becomes operated and owned on a private and profit-making basis.
<b>conservation</b>	Managing the way people use natural resources so that they give the greatest sustainable benefit today, while keeping their full potential to meet the needs and aspirations of future generations.
<b>degradation</b>	The result of poor resource use which pollutes, damages or reduces the quality of resources available to future generations.
<b>demography</b>	Measures of change in size and age structure of a population.
<b>disturbed</b>	Change in the natural order as the result of human activities or climatic change.
<b>ecology</b>	Branch of biology which deals with the relation of plants and animals to their environment.
<b>economic growth</b>	The increase in the value of goods and services produced in a country, usually measured over a year.
<b>ecosystem</b>	A community of plants and animals and the environment they inhabit.
<b>effluent</b>	A liquid flow.
<b>endangered species</b>	Species that are in danger of disappearing.

<b>endemic</b>	An animal or plant which is found only in one region or country and is not present naturally in any other part of the world.
<b>environment</b>	All the living and non-living things in a particular place or on the earth generally, and the way they interact or work together.
<b>erosion</b>	The wearing away of the earth's surface (for example, soil) by the action of water, wind etc.
<b>eutrophication</b>	The process in which high levels of nutrients encourage the growth of small plants called algae which use up so much oxygen that nothing else grows.
<b>fauna</b>	Animals.
<b>feasibility study</b>	A study of the practicability of a proposed project.
<b>flora</b>	Plants.
<b>food-chain</b>	A series of organisms each dependent on the next for food.
<b>geology</b>	The science of the earth, including the composition, structure and origin of its rocks.
<b>geomorphology</b>	The study of the physical features of the earth's surface and their relation to its geological structure.
<b>greenhouse effect</b>	The trapping of the sun's warmth in the lower atmosphere of the earth caused by an increase in carbon dioxide due to increased pollution. Carbon dioxide is more transparent to solar radiation than to the reflected radiation from the earth.
<b>gross domestic product</b>	The money value of all goods and services produced in a country. This value is used to measure a country's national income over a year.
<b>groundwater</b>	Water found in soil or in the pores and crevices in rock.
<b>habitat</b>	The natural home of a plant or animal species.
<b>indigenous</b>	Something that originally occurred in a particular area.
<b>infrastructure</b>	The basic structural foundations of a society or enterprise. Also refers to basic facilities such as roads, airports, electricity and communication systems; typically, their development is costly and is undertaken by governments.
<b>introduced species</b>	A species which does not naturally occur in a particular area but rather has been brought in from outside.
<b>leachate</b>	Water which has seeped through the earth, a rubbish tip, mine waste etc., and hence carries impurities.
<b>natural resource</b>	A naturally occurring stock or supply which can be used to help meet human needs and wants.
<b>nutrient</b>	A substance providing essential nourishment for the maintenance of life.
<b>organic</b>	Relating to plants, animals or other living matter.
<b>ozone layer</b>	A layer of ozone in the stratosphere which absorbs most of the sun's ultraviolet radiation.
<b>pelagic fish</b>	Fish that live in the open ocean rather than close to shore.
<b>pesticide</b>	Chemical that kills unwanted organisms.
<b>private sector</b>	Activities and enterprises run by individuals or groups on a profit-making basis.
<b>public sector</b>	Activities and enterprises run by government.
<b>recycle</b>	To convert something to reusable material instead of throwing it away.
<b>remittance</b>	Money transferred between countries, for example, Tuvaluans abroad sending money to their families at home.
<b>resource</b>	A stock or supply which can be used to help meet human needs and wants.

<b>sediment, sedimentation</b>	Matter which settles to the bottom of a liquid.
<b>sewage</b>	Waste matter, especially from toilets, conveyed in sewers.
<b>species</b>	A scientific name given to each different type of animal or plant.
<b>strategy</b>	A plan to help achieve certain goals.
<b>subsistence</b>	Producing mostly for own consumption, for example, farming which directly supports the farmer's household without producing a significant surplus for trade.
<b>sustainable</b>	Using a resource in such a way that its supply and quality are maintained indefinitely into the future.
<b>toxic</b>	Poisonous.
<b>vegetation community</b>	A commonly occurring grouping of plants and trees.



# Executive summary

## Introduction

With the support of the South Pacific Regional Environment Programme (SPREP), the Government of Tuvalu is committed to the preparation of a National Environmental Management Strategy (NEMS). Before this Strategy can be prepared, the main environmental issues facing Tuvalu need to be described and assessed. The purpose of this State of the Environment Report is to describe these issues and provide a background and context for the government in its next task of preparing the national strategy.

This report was prepared by an external environmental planning consultant over about ten weeks and draws on information gained through discussions with technical staff in the key environment related ministries, and from documentation available in Tuvalu.

The report describes and examines the issues under various sectors. These are:

- ◆ natural environment;
- ◆ human environment;
- ◆ economic and built environment;
- ◆ managing the environment; and
- ◆ priority programmes.

## Natural environment

This part describes the geophysical features of Tuvalu. These include young, poorly developed and generally infertile soils which, when combined with an extremely limited land area strongly affected by the saline influences of the sea, pose a major constraint on the agricultural potential of the country. A small population has traditionally survived by fully utilising the very limited range of

plant and animal species that have adapted to the atoll environment, and by exploiting the much greater resources of the marine environment. This balance is now being disrupted, however, by large increases in population, particularly on Funafuti. The development of a cash economy has, to a degree, made the population less reliant on the limited land resource but more dependent on foreign aid.

This part also deals with the climate, the issue of climate change, and the effect of a potential sea-level rise. The report concludes that while a matter of great long-term significance, the actual effects of climate change cannot be accurately predicted and that, given the time frames involved, no precipitous action is required. While the issue should remain on the government's agenda, climate change is not one of Tuvalu's main or high priority environmental issues within the likely time frame of a national environmental strategy.

The island-building and coastal processes of coral reef islands is also described and attention is drawn to activities which interfere with this natural system. These include the extraction of rock and sand from the ocean foreshore on Funafuti atoll, the construction of sea walls which interfere with the natural erosion and accretion processes, and the clearance of vegetation from the islands, especially from the foreshores. The potential environmental effect of continuing to remove large volumes of earth material from foreshores must in future be a cost factored into development proposals. The scarcity of earth resources will be a major constraint on the continued development of Tuvalu's built environment.

The need to maintain biodiversity and food stocks are key concerns in the marine environment. While relatively abundant, most marine resources located in the Exclusive Economic Zone (EEZ) are

difficult to exploit. However, the lagoon and reef resources which supply the vast proportion of food from the marine environment are being subjected to increasing pressure from modern fishing techniques and a rapidly rising population. Funafuti lagoon is under particular pressure and urgent action is required to conserve resources and maintain biodiversity by a combination of reducing fishing pressure in the eastern sector of the lagoon, and establishing protected domains to provide permanent marine conservation areas.

### **Human environment**

The two key issues in this sector are considered to be causes rather than symptoms of Tuvalu's environmental concerns. These issues relate to population growth and environmental education.

The pressure of population growth (at present on Funafuti, but anticipated on some other islands in the future) is Tuvalu's most pressing environmental problem. The nation does not have the natural or economic resources to accommodate this growth in the long term. Funafuti has a population which is already beyond sustainable levels, and the same issue will apply to other islands in the future. The report suggests the need for a population strategy based on both the control of population growth and the decentralisation of activities and facilities to encourage people to stay on, or move back to, the outer islands.

Environmental education is also a critical factor in addressing current environmental concerns and preventing future problems. Making people aware of the impact of their everyday actions and giving them a capacity to change the way they do things would be a major achievement in environmental protection. Tuvalu's "Education for Life" programme could incorporate an environmental education element. SPREP and other organisations now publish a range of resource material for teachers and students to facilitate the introduction of environmental education into school curricula.

### **Economic and built environment**

This part deals with a range of issues relating to the development of Tuvalu. It briefly notes the structure of the economy as being a mix of subsistence and cash types. One of the main requirements

identified is the need for close integration of Tuvalu's environment and development strategies: the NEMS provides this opportunity.

The main development issues concern the importance of good sanitation services and the need to take action to deal with solid waste pollution (probably the most obvious environmental problem in Tuvalu). Because of a reliance on septic tanks and absorption pit toilets (and the use of the beach as a toilet), water quality is also a potential concern, particularly where groundwater is utilised for domestic or agricultural purposes. Water quality in the Funafuti lagoon may also be of concern, given the concentration of population and the lagoon's likely poor flushing capacity. A water quality monitoring programme is suggested. Reliance on the discharge of sewage effluent to ground is also questionable over the long term.

The environmental impact of new development can be significant as can the continuing impact of existing activities. Tuvalu does not routinely subject new proposals to an assessment of their potential environmental effects. The report discusses the need to institute an Environmental Impact Assessment (EIA) process for all new major proposals, and environmental audits for a range of existing operations which are currently having, or could potentially have, an adverse environmental impact.

A further issue relates to the need to prepare land use and development plans for the islands to prevent the location of new activities being determined solely on the basis of land ownership. The objective is to avoid land use conflicts by ensuring that incompatible uses remain separated. The land resources survey undertaken during the late 1980s, updated cadastral plans, and the new landowner register provide a good basis for undertaking this task.

### **Managing the environment**

The government's central role in managing the environment is outlined, together with a description of organisations and their associated coordination arrangements. Though these arrangements are considered appropriate, the agencies themselves need to acquire a better understanding of the effects of their activities on the environment, and to begin to make proper assessment of their own proposals. The need for an environmental protection agency is discussed

with the conclusion that activity levels in Tuvalu are such that a specialist body is not required. With assistance, the Environment Officer's current role is considered appropriate. However, the report suggests that, either alone or in cooperation with other small South Pacific nations, Tuvalu could use the services of the existing technical or environmental protection agencies in the region when requiring specialist or expert advice on environmental matters.

Land tenure arrangements and the environmental laws of Tuvalu are briefly described. There is no modern or overarching environmental law in Tuvalu, but the report notes that sufficient power exists, particularly under the Local Government Ordinance, to enable government to carry out a comprehensive environmental protection and land use planning programme. This will, however, only be effective if changes are made to the current arrangements which give island councils the legislative power for these functions: the councils have neither the resources nor the staff to undertake this work. The report also notes that because of the dominance of the government sector, a policy de-

cision, and directives to agencies to undertake their activities in a sensitive manner and subject their major proposals to an EIA process, would be as effective as a new set of environmental laws.

The need for an environmental monitoring programme is also discussed. Without adequate information, decision making will not be based on a clear understanding of the changes taking place in the environment. There is a wide range of base information available, much of which is provided by the Tuvalu land resources survey, air photos and maps. A programme is required to gather similar base material in the marine environment, particularly the lagoons, so that changes to the environment can be assessed and the knowledge gained used to assist in decision making.

### **Priority programmes**

This provides a summary of suggested programmes and projects which could be considered in the development of the NEMS.







# Introduction

## 1.1 Overview

Tuvalu is a small and fragmented land, and one of the world's smallest self-governing nations. While it covers an ocean area of some 1.3 million sq km, its actual land area is only 25.9 sq km. This land area is split between nine island groups which are located between 5° and 10° south and 176° and 179° east. Tuvalu is approximately 1,100 km north of Suva, Fiji and 250 km south of Kiribati. With elevations of generally less than three metres and a population of nearly 10,000 people, Tuvalu is at considerable risk from natural disasters and environmental threats induced by human activity. Human induced threats are a particular concern on the capital atoll of Funafuti. Almost 4,000 people squeeze onto the main islet of Fogafale which has an area of only 2.8 sq km (a third of which is uninhabitable because it is used for airfield purposes or contains excavated borrow pits).

The Government of Tuvalu has adopted a two-tier environmental policy. This policy is spelt out in the Medium Term Economic Framework Programme which is the government's economic development plan for the period 1992 to 1994. The policy states:

The principal aim (of the economic plan) with regard to the environment is to keep the issue of global warming on the international agenda. This will be achieved by using international forums to promote the Government's views on the impacts of environmental degradation, especially in the Pacific region. There is also a need to ensure that social and economic activity in conjunction with overall development strategies are environmentally sound. Toward this end, assistance will be sought from development partners to improve management of the domestic environment (Government of Tuvalu 1992)

At the Fourth Pacific Islands Conference of Leaders (June 1993) and in the foreword to this document, the Prime Minister of Tuvalu has stated that in the rapid nation-building stage that emerged after Tuvalu gained independence in 1978, the issue of sustainable development had been inadvertently ignored or not assigned the priority it deserved.

The government has now committed itself to a development model that is both economically and environmentally sustainable. This report is part of the process of assessing the environmental issues confronting Tuvalu and will contribute to the development of a National Environmental Management Strategy (NEMS). This Strategy will integrate with the Economic Framework Programme to promote the sustainable development of Tuvalu.

This report is only one of a number of sources of information which will assist the people of Tuvalu to prepare a national environmental strategy. Much has been written in the past and these documents are referred to in a reference list which has been included in this report. In addition, key sectoral references are also listed throughout this report. The major reports that will guide the development of a national strategy are:

- ◆ *Tuvalu: State of the Environment Report 1993* (this document);
- ◆ *Environmental Legislation Review — Tuvalu, 1994* (Pulea & Farrier 1994);
- ◆ *Review of Environmental Education — Tuvalu, 1992* (Bektas 1992);
- ◆ *Tuvalu: Medium Term Economic Framework Programme, 1992–1994* (Government of Tuvalu 1992b);
- ◆ *Implications of Climate Change and Sea Level Rise for Tuvalu* (Aalbersberg & Hay 1992); and

- ◆ *Water and Sanitation Plan for Tuvalu for the Period 1993–2002* (Reynolds 1993).

## 1.2 Scope of report

In order to keep this report concise, readable and practical, it will not exhaustively describe every social, economic and environmental issue of Tuvalu. Rather, it is intended to assist and stimulate discussion on key environmental issues. As a result it is less a description of the state of the environment and more a discussion and analysis of the major issues in the key sectors. There is also an emphasis on highlighting courses of action which could be adopted in the national strategy. Readers are directed to other references (where these exist) for a more detailed discussion of the sector of interest. The purpose of this approach is to focus discussion on a set of environmental management and protection projects which can then be placed in priority for action within the national strategy. This strategy based on priority projects can then be used by the Government of Tuvalu in discussions with development partners and during the budget-building process.

It is important that a discussion of the environment is not exclusively negative and that the environmental issues confronting Tuvalu are put into perspective. One important point to remember is that the environmental problems which Tuvalu must deal with in the short term can be solved. In fact, the environmental condition of all the islands other than Funafuti could be considered as good.

The major concerns for Tuvalu relate to the pressure of population growth, mainly on Funafuti. Without increasing its reliance on imports, the population of Funafuti is probably already well beyond sustainable levels. This pressure is the principal cause of immediate problems such as the provision of adequate water and sanitation services, the control and management of solid and chemical wastes, and the depletion of lagoon fish stocks and other damage to this marine habitat.

High population levels also substantially reduce the ability to deal with unpredicted disasters. It is also worth stressing that the physical nature of Tuvalu means that action which would have insignificant environmental effects in other parts of the world can here have a major impact. The limited

land area available means that there is no room for mistakes and nowhere to retreat.

To prevent and overcome environmental problems, Tuvalu will need a range of well directed physical and institutional resources, plus the will and commitment to use them. The most important factor is knowledge. Environmental education, not just in schools but throughout society and throughout people's lives, is a fundamental requirement. If people understand the impact their actions have and are given the opportunity and support to change how they do things, many important environmental concerns can be overcome. To support an education programme, adequate institutional arrangements need to be put in place. Technical knowledge (or access to it) is also an important factor, as are the financial resources to undertake remedial, protection or assessment programmes.

Any statement which attempts to put the environmental issues of Tuvalu in context must also include comment about the possible effects of climate change and sea-level rise. The scientific debate continues about the extent, time scale and regional effect of climate change.

While this issue is of critical importance to Tuvalu in the long term, this report focuses on the environmental issues which should be addressed in the short term and by actions on the domestic front. The government's policy of keeping the international climate change debate alive and encouraging industrialised countries to act to reduce greenhouse and ozone depleting substances is the only course of action available on this issue. Until more definite evidence is available about the nature, effects and time scale of any change, the government can do little on the domestic front in relation to climate change other than monitor the physical changes and begin to debate national options for responding to the various climate change and sea-level rise scenarios described by the Intergovernmental Panel on Climate Change (IPCC). The Aalbersberg and Hay report (1992) is a good foundation from which to begin such debate.

Relative to the volume of reports that have been prepared on the environment and associated issues, action to address current problems has been relatively limited. This is partly because of the fact that much environmental protection work is of an ongoing or recurrent nature, rather than the capital projects which external funding agencies would



prefer to deal with. Another factor is that reports in themselves are cheaper to prepare than action projects. To be a success, the NEMS will need to be more than simply another report on the shelves of

public servants and consultants. In conjunction with the economic development programme, it should provide directions and establish a prioritised environmental protection programme.



Fishing is a very important part of Tuvaluan life. The subsistence sector provides a significant portion of the food resource for most people. Here, Tuvalu's Environment Officer, Alefaio Semese, engages in this traditional activity using non-traditional methods. (photo: John Lane)

### 1.3 Sources and methodology

This report was commissioned by the South Pacific Regional Environment Programme for the Government of Tuvalu. It was prepared by an environmental planning consultant between May and July 1993 from information drawn from a range of publications made available in Tuvalu and through direct observation of the environmental problems evident on Funafuti atoll. Additional information was obtained through consultations and discussions with government officers and external consultants present in Tuvalu during this period. This included technical and scientific staff in the Public Works Department and the Fisheries and Lands and Survey Divisions, and marine biology consultant Ursula Kaely. The following were the main resource documents relied on while preparing the report.

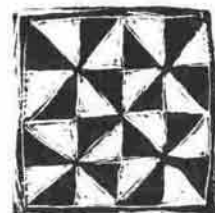
- ◆ *Implications of Climate Change and Sea Level Rise for Tuvalu* (Aalbersberg & Hay 1992)
- ◆ *Tuvalu: Medium Term Economic Framework Programme, 1992–1994* (Government of Tuvalu 1992b)
- ◆ *Country report for UNCED: Tuvalu* (Government of Tuvalu 1992a)
- ◆ *Tuvalu Land Resources Survey: Country Report* (McLean & Hoskings 1991b)
- ◆ *Water and Sanitation Plan for Tuvalu for the period 1993–2002* (Reynolds 1993)
- ◆ *Kiribati Vulnerability to Accelerated Sea-Level Rise: A Preliminary Study* (Woodroffe & McLean 1992)





*PART I*  
*Natural*  
*environment*

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# Geology and geomorphology

## 2.1 Introduction

In 1842 Charles Darwin first developed a theoretical basis for describing how mid-oceanic coral atolls and coral reef islands, such as those which make up Tuvalu, came into existence. He suggested that coral reefs began as fringing reefs to volcanic islands that were gradually sinking relative to the sea level. As the volcanic island sank, continuing coral growth kept the reef top at or near sea level. The lower or earlier layers of reef were gradually transformed by the forces of compression into limestone. The reefs near the surface gradually evolved to form the atoll land systems evident now. Recent geological research has generally substantiated Darwin's original theory, although it is now recognised that the process of reef growth has been interrupted by changing sea levels related to ice ages of the Quaternary period.

On the global scale, sea levels have been gradually rising to their present level from a low point reached some 100,000 years ago during the ice ages. However, within this general change there have been periods of fluctuation. For example, in the recent geological past (3,000 to 4,000 years before the present) there is evidence to suggest that sea levels in the western Pacific were somewhere in the order of a metre above present levels. The islands that exist today, while still subject to continuing change through erosion and deposition, have probably been in their current form for only 2,000 to 4,000 years — in geological terms, a very short time. The preliminary study by Woodroffe and McLean (1992) on the vulnerability of Kiribati to accelerated sea-level rise provides a good referenced discussion on the development of reef islands on coral atolls.

Of the nine island groups that make up Tuvalu,



*Crushed rock for construction is excavated from the ocean foreshore, thus reducing the protection offered by the natural 'sea wall' built by Cyclone Bebe.  
(photo: Alefaio Semese)*

five can be considered to be true atolls (Nanumea, Nui, Nukufetau, Funafuti and Nukulaelae), three are table reef islands (Nanumaga, Niutao and Niulakita) while Vaitupu (with the largest land area) has composite characteristics of an atoll and a table reef island.

## 2.2 Geomorphological issues

A key point is that the land is geologically very young, with most islands having poorly developed, infertile, sandy or gravel coralline soils. The atolls are also very dynamic. Sediment is constantly being produced by the forces of the sea; reef growth, where not retarded or stopped by human interference, continues. The islands themselves are subject to continual erosion and deposition, some of this occurring over a relatively long period but some occurring very rapidly as a result of major storms. The rock rampart which developed on the eastern ocean side of Funafuti atoll during Cyclone Bebe is testimony to how quickly substantial changes can occur.

Given the very small area of habitable land available in Tuvalu and the dynamic nature of the atoll land system, great care should be taken before any works are carried out that may change the foreshore. Activities such as extracting rock and gravel from foreshores (particularly from the ocean side of islands), blasting channels, building sea walls or dredging from lagoons should be assessed for their potential impact before works begin, and monitored during and after operations. Given the nature of the geomorphological processes at work and the limited economic resources available to Tuvalu to remedy mistakes, it is reasonable to suggest that, as a general rule, works requiring major changes to shorelines should not be permitted.

## 2.3 Further reading

- McLean, R.F. & Hoskings, P.L. 1991a.  
Geomorphology of reef islands and atoll motu in Tuvalu. *South Pacific Journal of Natural Science*, vol. 11, pp. 167–189.



### 3.1 Description of climate

Tuvalu's climate is described as tropical and marine. The country is located in the south-east Pacific trade wind belt just south of the dry belt of the equatorial oceanic climate zone. Though Tuvalu was generally thought to lie outside the southern cyclone belt, it suffered significant damage in 1972 from Cyclone Bebe and has experienced an increasing frequency of cyclones since the late 1980s. While only 11 cyclones were recorded between 1940 and 1970, 13 were recorded between 1972 and 1985, and seven between 1985 and 1992. There is also historical evidence of a major cyclone in the late 19th century. While some of the apparent increase in the number of cyclones can be put down to better record keeping, recent cyclone activity has been generally attributed to shifts in weather patterns over a large part of the Pacific. Much of this change is considered to be cyclical, although global warming induced by human activity may be contributing to an intensification of this natural occurrence.

More detailed discussion of Tuvalu's climate can be found in a number of recent reports including the 1987 New Zealand Meteorological Service report on the climate and weather of Tuvalu which was based on meteorological data for the period 1951–1980. In brief, the main features of Tuvalu's climate are as follows.

#### **Wind**

Wind over 22 knots only occurs between two and four per cent of the time. Gale force winds (over 33 knots) are relatively rare and mostly occur as west to north-west winds during the cyclone season from November to April. From May to October winds are generally light and from the south-east.

#### **Rainfall**

Rainfall varies throughout the island group with the southern islands receiving around 3,500 mm per year, decreasing to about 2,700 mm per year in the northern islands. Rainfall variability is generally moderate but significant in the north. Dry spells and droughts are relatively uncommon (though more common in the northern islands). However, as above-ground water storage is limited and potable groundwater unreliable or absent, dry spells of even relatively short duration can cause significant hardship.

#### **Air temperatures**

Air temperatures are essentially uniform throughout Tuvalu. Mean daily maximums and minimums are 31°C and 25°C respectively. Temperatures in excess of 34°C occur every two years or so, while temperatures below 21°C occur once every three or four years in the south and once every ten to fifteen years in the north.

#### **Sea temperatures**

Sea temperatures (surface) vary little from a mean of 29°C. Nearly all reported waves and swells are under three metres, with most having an easterly direction. Sea surface temperatures are thought to have risen by 0.5°–1.0°C since the beginning of the 20th century.

### 3.2 Climate change

#### 3.2.1 General

The key reference for an assessment of the effects on Tuvalu of climate change and sea-level rise is the report by Aalbersberg and Hay (1992). This report



should be used as the basis for the development of responses to climate change in the NEMS.

Early predictions of the impact of the greenhouse effect on global temperatures and consequential sea-level rises are now considered to be too extreme. The most respected current estimates are those of the Intergovernmental Panel on Climate Change (IPCC) in 1990, updated in 1992, which suggest an approximate rise in global temperature of 2°C by 2050 and a sea-level rise of about 0.36 m by the same year. The IPCC tempers these figures by suggesting possible variations of  $\pm 0.15^\circ\text{C}$  for temperature change and  $\pm 0.3$  m for sea-level rise predictions. There now appears to be general acceptance that global temperatures are increasing. There is still a considerable degree of debate over how much global temperatures are rising, the cause of this (whether human activity or a natural cycle), and the likely impact any changes might have on global sea levels. In addition, there is also a limited understanding of the implications of these predicted global changes in regional areas such as the Pacific.

Woodroffe and McLean in their study of Kiribati (1992) note "the potential consequences of sea level rise remain uncertain ... [but, from evidence stated] ... the present situation is not one of immediate crisis ... there is time to undertake monitoring and research". The recommendations of the Aalbersberg and Hay study of Tuvalu (1992) reflect a similar position. One means of planning for a potential catastrophic effect on Tuvalu is to begin to explore the options available for the various sea-level rise scenarios.

Woodroffe and McLean state that a rise in sea levels is likely to be experienced in three ways:

- ◆ changes to coastal erosion patterns;
- ◆ effects of more intense and frequent storms; and
- ◆ effects of flooding of low-lying areas caused by a rise in groundwater levels or overwashing of waves.

### 3.2.2 Recommendations for action

Based on their assumption that the threats from sea-level rise are not so immediate as to require precipitous action, Woodroffe and McLean make a number of recommendations for short-term action which are as relevant to Tuvalu as they are to Kiribati.

- (1) Collect or consolidate basic environmental data for the whole country. Tuvalu already has a comprehensive land information base prepared by McLean and Hoskings (1991b). The report, *Tuvalu Land Resources Survey*, has a country-wide volume plus a separate volume for each island. In addition, information gained from the sea level monitoring station located on Funafuti wharf can be added. Other resources such as air photos and good topographic and cadastral mapping will be useful (some of these resources are already available).
- (2) Undertake systematic cross-island environmental surveys to gauge the susceptibility of different areas to inundation under present conditions and possible conditions in the future.
- (3) Run programmes of research about the coastal processes of the islands (sediment production, transport and deposition); monitor beach and shoreline profiles in both inhabited and uninhabited areas so that an accurate record of changes can be maintained.
- (4) Undertake a coastal zone mapping programme to identify areas most vulnerable to erosion. The purpose of mapping sensitive areas is to provide a tool to enable land use decisions to be soundly based (for example, building setbacks and protecting vegetation to identify foreshores where the extraction of earth materials should be restricted or prohibited).
- (5) Restrict generally and prohibit in places close to built-up areas the collection of reef rock from areas of reef platform; and restrict the collection of sand and shingle from beaches in areas already known to be vulnerable.

The Intergovernmental Panel on Climate Change has prepared a common methodology for the assessment of vulnerability to accelerated sea-level rise. One of the seven steps in this process is to identify specific response strategies, or possible measures a country can take in the face of a rise in sea level. The four response strategies identified by IPCC are noted without comment as they could be options debated during the development of the NEMS. They are:

- ◆ do nothing;
- ◆ retreat;

- ◆ protect; and
- ◆ accommodate.

The potential impact of climate change and sea-level rise is so large (despite the potential being very uncertain) that this issue has tended to overshadow other environmental problems which are known and of immediate concern to Tuvalu. While the NEMS will need to address the important issue of climate change, this issue should not be permitted to dominate or lead to the neglect of more urgent problems. Climate change is not the most important or the most urgent environmental problem facing Tuvalu in the medium term.

### **3.3 Further reading**

- Aalbersberg, W. & Hay, J. 1992. Implications of Climate Change and Sea Level Rise for Tuvalu: Report of a Preparatory Mission. South Pacific Regional Environment Programme, Apia, Western Samoa.
- McLean, R.F. & Hoskings, P.L. 1991b. Tuvalu Land Resources Survey: Country Report. A report prepared for the Food and Agriculture Organization of the United Nations acting as executing agency for the United Nations Development Programme. Department of Geography, University of Auckland, Auckland, New Zealand.
- Woodroffe, C.D. & McLean, R.F. 1992. Kiribati Vulnerability to Accelerated Sea-Level Rise: A Preliminary Study. Unpublished report to the Department of Arts, Sports, Environment and Territories, Government of Australia, Canberra, Australia. 82 pp.



# Land and coastal environment

## 4.1 Introduction

The land resources of Tuvalu are extremely limited. This is mostly a product of its geology and very small available land area, together with a very large ratio of foreshore to overall land area. Other natural characteristics also limit the ability of Tuvalu to rely on its land resources:

- ◆ soils are coarse, poorly developed and generally have a low fertility;
- ◆ agricultural potential is limited in terms of species that can be grown and the volume of product able to be produced;
- ◆ only limited water supplies can be provided from ground or surface sources (this difficulty is offset by the generally high annual rainfalls received);
- ◆ mineral development prospects on land do not exist apart from small phosphate deposits on some islands;

- ◆ earth materials (sand, gravel and stone) can only be obtained at considerable environmental expense — either because precious land area is made essentially unusable (such as the borrow pits on Funafuti) or because extraction from foreshores can directly lead to increased erosion and susceptibility to storm impacts;
- ◆ there are long lengths of coastline susceptible to erosion.

A very comprehensive land resource survey has been carried out for all the islands of Tuvalu (McLean & Hoskings 1991b). The survey work was carried out during the early to mid-1980s and the reports were published progressively (nine island reports and one country report were reprinted in 1991). This survey, which was prepared by McLean and others with a stated bias towards agricultural development, provides not just a detailed description of the land



Sand dredged from Funafuti lagoon is used to reclaim low-lying areas.  
(photo: Alefaio Semese)



resources of Tuvalu but also a comprehensive basis for land use planning, management and decision making. A substantial amount of information about the physical environment of Tuvalu can be found in the volumes of this report. A brief description of the main features follows.

## 4.2 Soils

The atoll soils of Tuvalu are among the most infertile in the world. They are young, shallow, alkaline, coarse textured and of a carbonate mineralogy. Due to their age they are poorly developed and similar to the original coral limestone parent material. They range from 250 mm to 1,000 mm in depth and consist of a variable layer of organic material, coral sand and rock fragments overlaying a limestone platform. There is some accumulation of clays and hydrogen sulphide near the centre of islets close to the water table. The chemical structure of the soils make the scarce trace elements of iron, manganese, copper and zinc unavailable to plants. Activity of soil micro-organisms is limited, soil water-holding capacity is low, and the groundwater is often saline. Plant growth is highly dependent on organic matter for the concentration and recycling of plant nutrients.

Levels of organic matter can be relatively high in undisturbed soils under natural vegetation. In disturbed areas, however, they can decrease dramatically. Mulching of all available leaf and vegetable material is common practice for the people of Tuvalu. This usually occurs around banana plantations and in 'pulaka' pits (in which taro is grown).

Scattered throughout Tuvalu are areas of phosphate-rich soils and phosphate deposits which have originated from guano deposits accumulated over long periods under bird rookery sites. In some low-lying areas on the islets, there are poorly developed, but relatively fertile, wet soils. Vaitupu has the most extensive area of fertile soils, possibly related to a better developed freshwater lens.

## 4.3 Earth and mineral resources

Mineral deposits in Tuvalu are virtually non-existent. Guano deposits were mined in the late 1800s but those that currently exist could, if exploited, supply local agricultural needs only. In this respect they could assist in expanding Tuvalu's domestic

food production which would lead to a reduced reliance on imports.

There are limited prospects of finding mineral rich nodules or crusts (polymetallic manganese and copper) on the ocean beds within Tuvalu's EEZ. Further investigation is necessary and if deposits were found, early development would seem unlikely.

Earth materials are relatively abundant but as noted above are usually extracted at significant environmental cost (or potential cost). The limited ability of Tuvalu to provide earth resources in an environmentally sound manner could become a key constraint on development projects. This is particularly true for projects which may require large volumes of earth materials such as sea walls, land reclamation works and airstrip construction or extension.

## 4.4 Land plants

### 4.4.1 General

The indigenous plants of the atolls are few in number. In addition, humans have significantly modified natural systems through agricultural and urban development. Even on uninhabited islets, natural systems have been modified by the planting of food crops such as coconuts. Despite this poor representation and additional modification, there is a strong case for maintaining the biodiversity of the land flora to maintain species diversity and for utilitarian purposes. It is estimated that there are fewer than 200 plant species in Tuvalu and of these a maximum of 50 are possibly indigenous. None are endemic. Most exotic plants consist of ornamental species, food plants and weeds.

Although exotics dominate the species list, it is the indigenous plants which are the most useful for cultural or utilitarian purposes. They exist even in disturbed habitats and are ecologically important species. Because of their ecological and utilitarian significance, the protection and enhancement of indigenous species is important.

### 4.4.2 Vegetation communities

The main vegetation communities consist of coconut woodland in stands of varying age and condition. It has been estimated that an average of 67 per cent of the area of outer islands is occupied by this vegetation community. Others include coastal

strand vegetation, limited areas of coastal marsh vegetation, and some small remaining areas of indigenous inland broad-leaf woodland, often represented by a few individuals standing together. There are also house, yard and village gardens, and areas — sometimes relatively large — of open, weedy (waste) lands. The land resources survey provides a very detailed and mapped description of the vegetation communities and their extent on all islands.

While vegetation communities are of mixed quality and remaining indigenous vegetation is extensively disturbed, these plants are nevertheless of critical importance to Tuvalu. Plants remain a major food resource despite the increasing tendency of the population to eat manufactured, generally imported goods, and vegetation continues to be used for an extensive range of utilitarian and cultural purposes. In an area of extremely high solar radiation, the importance of vegetation in providing shade, particularly around houses and in village areas, cannot be overestimated.

#### 4.4.3 Role in environmental protection

In terms of environmental protection, vegetation also plays a critical role. It can provide 'soft' protection for foreshores, preventing erosion at a much cheaper cost than the 'hard' protection provided by sea walls and, by stabilising coastal zone soils, can reduce the impact of storm surges. Vegetation inhibits the penetration of salt spray inland, which assists in the protection of some food crop species.

In decomposition, it provides one of the few (and inexpensive) methods of increasing soil nutrient levels while improving soil texture and water retention capabilities. Mangrove communities provide foreshore protection and are of value as a source of construction and handicraft raw materials. They are also essential nursery areas for many important fish and other marine food species. This last point is significant given the dependence of many Tuvaluans on produce from the sea.

Despite the importance of vegetation to the ecology as well as the material well-being of the Tuvaluan people, the retention of vegetation does not seem to be given a high priority. For example, anecdotal evidence in Funafuti suggests that in the last year or two, many trees have been removed from the village area following high winds and storms. This was done without an assessment of the actual danger or potential danger presented by the individual trees and despite the important role trees play in reducing wind speeds at ground level. In a further recent example, ocean coastal zone vegetation was removed to provide an area for the development of sports facilities. In this case, vegetation which was providing significant protection and playing an important role in stabilising soils at the site, has been completely stripped back to the top of the rubble mound. It is reasonable to assume that in both examples little or no attention was paid to the valuable role of vegetation in protecting the environment.

The country report to the United Nations



An area of sensitive ocean foreshore was recently cleared to provide a site for sports facilities.  
(photo: Alefaio Semese)



Conference on Environment and Development (UNCED), argued:

... while floristic degradation in Tuvalu appears to be among the most severe in the Pacific, the vegetation and flora of Tuvalu still constitutes a strategic ecological and cultural resource that must be protected. Unfortunately, despite the undeniable developmental importance of vegetation protection in Tuvalu, there is still a need for planners and national development plans in Tuvalu to place a high priority on vegetation protection as a basis for sustainable development (Government of Tuvalu 1992a).

#### **4.5 Land animals and birds**

There are probably no indigenous land mammals in Tuvalu and the Polynesian rat is thought to have been introduced by the earliest inhabitants. The main indigenous land animals consist of birds, insects and some land crabs. Species of lizard and frogs are also present. The main domestic and introduced mammals include dogs, cats, common rats and pigs.

Birds, with a couple of introduced exceptions, are mostly sea birds or migratory species. Little data exists on the avifauna of Tuvalu, but the chain of islands probably serves as an important flyway for species that use islands for feeding on migratory journeys and for those that breed there. There are, of course, a significant number of domestic fowl. Ten families of birds are present on Tuvalu and 28 species have been reported. These are listed in Appendix 1.

Birds form a dietary supplement for many Tuvaluans although this may be becoming limited to the outer islands as population pressure on Funafuti restricts significant bird populations to the more remote islets on the western edge of the lagoon. Relative to other places, it is rare to see birds on Fogafale islet. It is also interesting to note that the bird species which are commonly eaten are all fully protected under Tuvalu's wildlife code.

#### **4.6 Coastal environment**

##### **4.6.1 General description**

For the purposes of this section, the coastal zone is considered the intertidal zone plus the area of foreshore regularly affected by wave action during tidal surges. While variations exist between the

islands and on islands depending on their orientation, a typical atoll ocean foreshore consists of a steep reef slope rising from considerable depths to a low reef crest at the seaward edge of a relatively narrow reef flat. These features are usually covered or, at least, covered at high tide. A small conglomerate platform is sometimes evident above the high water mark. The most obvious feature is the steep rubble mound, the top of which is often the highest point on an island. In undisturbed areas, thick coastal species vegetation grows on the top and down the lagoon side of the mound. This mound and vegetation offers good natural foreshore protection. The rubble mound is sometimes used as a source of earth material.

Lagoon foreshores are made up of finer, often sandy, material. A reef slope which rises from the shallow lagoon floor to the seaward edge of a broader reef platform is a common feature of a lagoon side coastal zone. The beach between the tidal extremes is usually made up of sand or rock broken from the reef area. From the high water mark the land rises to a mound which is lower and less steep than the ocean side.

The general theory of atoll island building is that sediments and beaches erode on the lagoon side, while new sediments (generated from the corals growing on the reef slope) are deposited and build up on the ocean side. Under common climatic conditions the process of erosion and accretion happens at a relatively slow rate, but during severe storms and tidal surges or as a result of human interference, this process can be rapid and extensive. Erosion along lagoon shores is often of great concern because of the concentration of village sites near lagoon foreshores. On some islands where there is no lagoon, or where urban or infrastructure developments are located by ocean shores, erosion and depositional activity (particularly during storms) is also of concern.

Coastal land systems are by their very nature dynamic in character. The processes of weathering (sediment production), erosion, and the transport and deposition of rock, gravel and sand are driven by the powerful forces of the sea. Tuvalu, with a coral reef type foreshore environment, has a large coastline relative to its land area and its coastal zone is more vulnerable to change than many other types of coastal land systems. The nature of atoll and reef island geology and geomorphology has already been discussed. However, in considering



the coastal environment, some of these features deserve emphasis:

- ◆ atolls and reef islands are geologically young and unconsolidated landforms, and are in a continual process of change;
- ◆ erosion and deposition of foreshore material are natural processes which are often modified by the actions of people through the construction of channels, land reclamation, erosion control and port works; and
- ◆ given the relatively rapid change that occurs to the landform of islands, it is probable that in the past the people of Tuvalu have had to accommodate these changes by moving away from eroding areas or moving onto accreting areas. Anecdotal evidence of this happening on Nanumea is given in the Fawcett and Partners report (Webber 1982).

#### 4.6.2 Coastal protection programme

The Fawcett and Partners report is the basis of the current coastal protection programme (sea wall construction) being carried out in Tuvalu. Phase One of the programme is essentially completed; however, little work has been done since the end of this phase in 1990. In March 1993, a survey of the condition of sea walls was carried out (Paul 1993). Work on Phase Two projects is expected to begin in late 1993.

The Fawcett design did not evaluate the possible use of vegetation in foreshore protection although it did note it was used successfully in some places. Its 'rubble wall' approach (using specially designed concrete blocks) was designed for a wave height condition that has an average return period of one year. While many of the walls were not built to specification, they have generally performed as designed. They were not designed to withstand cyclone force waves and therefore were damaged by cyclonic conditions in recent years. However, the simple design makes reinstatement relatively simple, provided replacement blocks and workers are available.

#### 4.6.3 Significance of coastal zone

The coastal zone is Tuvalu's first and last line of defence against the sea. While a naturally dynamic feature, it is sensitive to interference. At the same time, the coastal areas are the focus of human activities. This potential conflict must be taken into

account when coastal development projects or projects which rely on the extraction of coastal resources are being planned. In the light of possible effects caused by climate change and sea-level rise, it would be a sobering exercise to cost a project to provide sea wall protection equivalent to that offered naturally by the Bebe bank (a rock bank thrown up by Cyclone Bebe which has now been substantially excavated to provide earth resources for development projects on Funafuti).

In a natural environment the forces of erosion and deposition will generally balance along a sector of coast. Tuvalu's coast has been either modified, or human settlement has made sectors of the coast more strategically important, for example, village or agricultural land adjacent to the foreshore. It is usually considered essential to protect these assets by building coastal defence structures when they are threatened by changes to the coastline. Planning for this situation can prevent future problems: valuable assets should not be built on vulnerable coastal areas.

### 4.7 Land and coastal environment issues

A number of issues have been raised throughout the description of Tuvalu's land and coastal environment. Most of these relate to the way in which the environment is used by people, government and business. The most important issues to consider during the development of the NEMS are:

#### **Vegetation retention**

The importance of vegetation in the protection of soils and foreshores, and its usefulness as a source of food and for a wide range of utilitarian purposes, makes the retention and enhancement of vegetation a priority issue.

#### **Earth resources**

The uncontrolled extraction of rock, gravel and sand from foreshore areas will leave Tuvalu even more vulnerable to the forces of the ocean and less likely to be able to combat the threats caused by climate change or even current climatic conditions. Earth material should be managed as the precious resource it is. Development plans and projects must address this significant constraint.



The current practice of excavating rock and sand from the foreshore for development purposes is unsustainable. (photo: Alefaio Semese)

### **Soil**

While many of Tuvalu's food resources are found in the sea and, progressively, more are being found on the shelves of shops, food production from land will not only remain significant but should become more important if sustainable development is to be achieved. It is likely that protecting the best soils from urban development and maintaining knowledge of traditional soil enhancement practices will become important issues.

### **Species protection**

While the number and range of land animals and plants is relatively small, Tuvalu is an example of a relatively rare ecosystem and it is important for some species of birds. Many indigenous plants and plant communities are under pressure from continued urban and agricultural development. Larger species of trees, traditionally used for canoes and a range of other purposes, are rare in many areas. The maintenance of biodiversity is becoming an important consideration for Tuvalu.

### **Vulnerable coasts**

Coastal erosion can threaten valuable human assets. Natural events and human activities both contribute to foreshore erosion. Coastal protection works are expensive and cannot provide protection in all circumstances, but vulnerable areas can be identified. Land use decisions can be made in these areas to prevent the establishment of uses that may require expensive protection schemes at a later time.

### **Land use planning**

Rapid growth and development can lead to conflict between land uses. The establishment of large animal feed pens or industrial type uses amongst residential areas or close to special agricultural areas (such as 'pulaka' pits) is undesirable and can sometimes be a danger to health. While development pressure is not so great on the outer islands at present, growth rates on Funafuti and an assessment of current conditions indicate that a land use plan is long overdue.

## **4.8 Further reading**

- McLean, R.F. & Hoskings, P.L. 1991b. Tuvalu Land Resources Survey: Country Report. A report prepared for the Food and Agriculture Organization of the United Nations acting as executing agency for the United Nations Development Programme. Department of Geography, University of Auckland, Auckland, New Zealand. 119 pp.
- Webber, R.B. 1982. Report on the prevention of coastal erosion in Tuvalu. Report prepared by Fawcett & Partners for the Government of Tuvalu, Funafuti, Tuvalu.
- Woodroffe, C.D. & McLean, R.F. 1992. Kiribati Vulnerability to Accelerated Sea-Level Rise: A Preliminary Study. Unpublished report to the Department of Arts, Sports, Environment and Territories, Government of Australia, Canberra, Australia. 82 pp.



# Marine environment



## 5.1 Marine resources

### 5.1.1 General

Because of the importance of fish in the Tuvaluan diet, Tuvalu's marine environment is of critical significance. An informal household survey conducted in Funafuti in 1993 by the Fisheries Division found (from a sample of 50 households) that each person eats about 500 g of fish per day; that is, equal to 2000 kg per day or 730 tons per year across the population of Funafuti. When fish is available for sale in the streets, there appear to be many more buyers than fish available. It is therefore reasonable to draw the conclusion that despite the consumption estimates, the demand for fish is not satisfied in Funafuti. It is also likely that personal fish consumption is even higher on the outer islands which do not share Funafuti's cash economy and greater access to alternative foods.

Who supplies all this fish? The only information available is from a canoe and small boat survey

recently carried out in Funafuti by the Fisheries Division which found that this subsistence and semi-commercial group catch about 300 tons per year. It is assumed that because the total catch from the commercial sector (National Fishing Corporation of Tuvalu) has been relatively small in recent times, the majority of the remainder of fish eaten in Funafuti (about 430 tons per year) is caught by family and net fishers. For such an essential resource, it is of concern that so little is known about the sustainable yields of Tuvalu's fisheries. While detailed knowledge is limited, it is assumed that any adverse impact on fish stocks will be felt first in Funafuti. This area, therefore, deserves closest consideration.

### 5.1.2 Near-shore fisheries

The population growth patterns indicate that Funafuti is increasing in population at a significant rate; therefore, the pressures being brought on the lagoon and near-shore fisheries must similarly be



Fisheries Wharf, Funafuti. (photo: Alefaio Semese)

increasing. In addition, the commercial fishing fleet tends to fish the same waters as the smaller operators. By comparison, the population growth rates on the outer islands are generally slow, static, or declining. Pressure on the fish resources in these areas is unlikely to be increasing significantly.

There is no researched evidence to suggest fish stocks are low in Funafuti or elsewhere, but there is anecdotal evidence which suggests that much more effort is required to catch fewer fish. There is also limited evidence (from preliminary comments made by the group undertaking environmental monitoring of the Funafuti lagoon dredging programme) that the diversity of species and population levels of species has declined significantly over the last two years in areas adjacent to the main Funafuti settlement (Vaiaku to the deep-water jetty). It is also reasonable to assume that a resource that was feeding fewer than 1,000 people only 20 years ago but is now feeding four times that number must be under significantly increased pressure.

In the circumstances it is likely that fish stocks are not only declining but the diversity of species is also being reduced (some species may no longer be present in viable populations). Some species such as clams and turtles are now generally acknowledged as being rare. As well as population pressure (too many fish being taken), turbidity, high nutrient loads and poor flushing of inshore lagoon waters could be contributing to this apparent loss of biodiversity.

Other marine resources which are useful but probably not threatened by over-exploitation at present are edible seaweeds and shells collected for sale as specimens. It is suggested in the United Nations Conference on Environment and Development (UNCED) report that both could form the basis of a new sustainable industry in the future.

The threat from ciguatera (fish poisoning) is a major concern, particularly in Niutao, Funafuti and Nukufetau where outbreaks have been reported. An outbreak of ciguatera occurs following a population explosion of a form of toxic algae which is naturally present in tropical coral reef waters but usually only in small numbers. The algae is consumed by grazing fish and the toxic effects build up through the food chain. In humans, poisoning can bring on a range of reactions from mild effects to a fatal illness.

The trigger to the initial population explosion of the organism is not well understood; however, it

is believed that disturbances such as storms, channel blasting and dredging, or nutrient build-up may be contributing factors. With the people so dependent on the lagoon and reef fishery, a significant outbreak of ciguatera would be a disaster for the area.

### 5.1.3 Pelagic resources

Tuvalu has an enormous oceanic marine area of 1.3 million sq km. While the pelagic resources are not fished extensively by Tuvalu, a number of licences have been granted to foreign commercial fishing vessels to fish in Tuvalu's Exclusive Economic Zone (EEZ) and it is likely that other unlicensed foreign ships are exploiting this area as well. The government expects to earn on average about \$0.7m each year in licence fees. Limited surveillance and a lack of enforcement capability makes it difficult to catch unlicensed vessels. Tuvalu is awaiting delivery of a patrol boat being built in Australia which will improve its enforcement capability. There is a strong commitment by the South Pacific countries to work together on fisheries management programmes, particularly those involving international agreements.

It is not known whether the pelagic resource is currently being over-exploited. However, given the increasing exploitation of lagoon and near-shore resources, the pelagic resource may become very important to Tuvalu in the future. In developing a fishing industry strategy, it would seem sensible for the commercial sector to concentrate on the pelagic resource rather than compete with the artisan/semi-commercial sector which will continue to fish the lagoon and inshore reef resources.

## 5.2 Marine resource issues

The most significant and immediate issue is to make sure that the lagoon and reef fishery is not exploited beyond sustainable levels, particularly in Funafuti. With the limited evidence available on the situation in Funafuti, a range of actions should be taken in order both to learn more about fish stocks and to preserve species and populations. These actions could include:

- (1) requiring the commercial industry (National Fishing Corporation of Tuvalu, NAFICOT) to fish the pelagic resource rather than

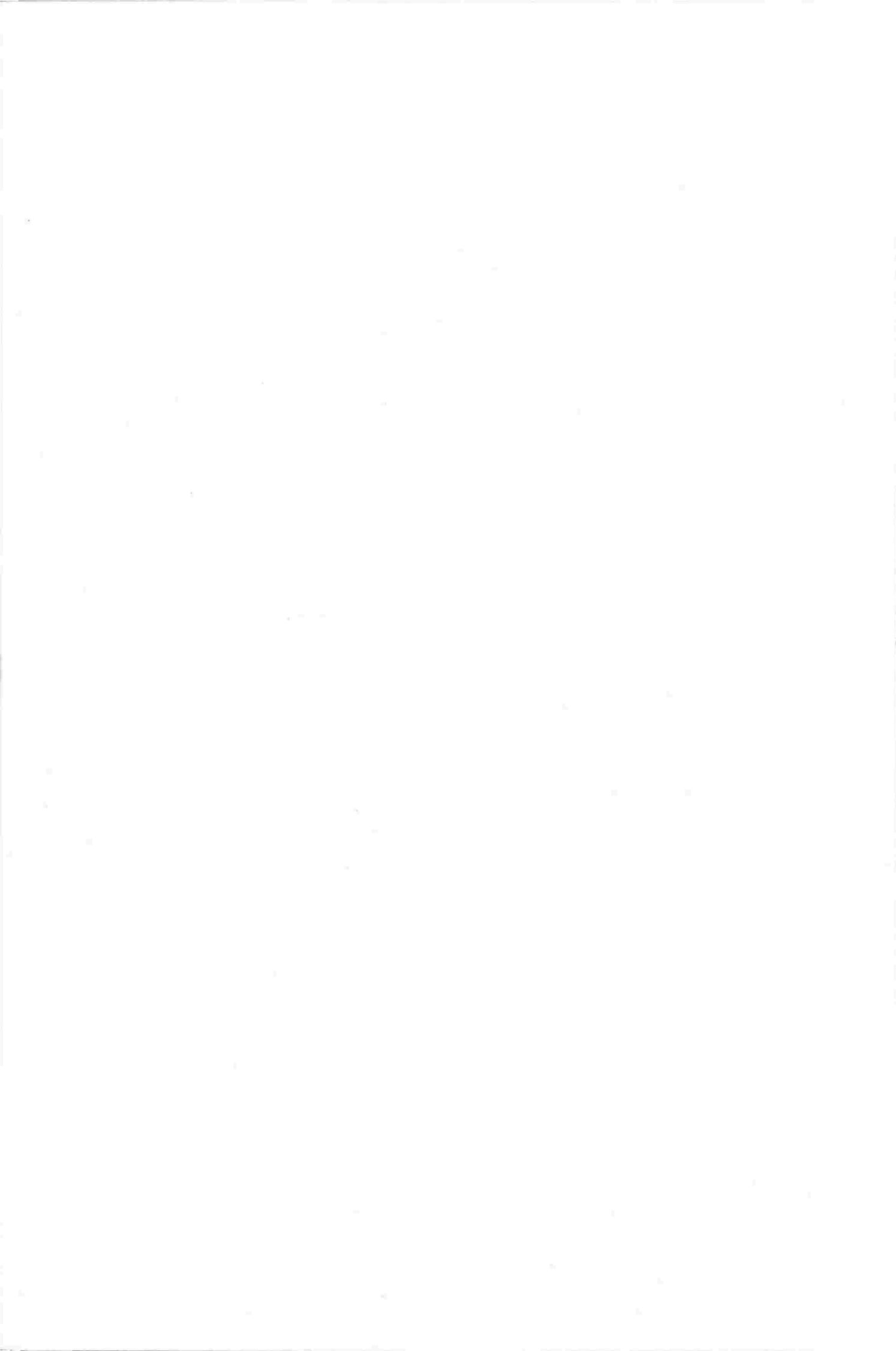


- compete with semi-commercial and family fishers for the lagoon and reef resources;
- (2) establishing permanent marine protected areas, representing different ecosystems, to give sanctuary to rare species and provide protected areas for fish breeding from which restocking can take place (maintenance of biodiversity);
- (3) undertaking a fish stock assessment survey (of key indicator species and the foods on which they rely) and an assessment of the threat from ciguatera;
- (4) instituting a system whereby areas are rested from fishing for a period of time to encourage the recovery of marine species. This system has traditionally been used on some islands where island councils close certain waters for specific periods for cultural or management reasons;
- (5) discontinuing fishing for species acknowledged as being rare such as giant clams and turtles; and
- (6) stopping the practice of net fishing in those lagoon areas subject to heaviest fishing pressure, for example, offshore from village areas.

In promoting new projects based on marine resources, whether it be specimen shell collection, seaweed harvesting or some other enterprise, the fundamental principle behind their design should be the maintenance of biodiversity with exploitation kept to sustainable levels. Sustainability is also a key factor in the further development of the pelagic based, commercial industry.

### 5.3 Further reading

- Parkinson, B. 1984. The specimen shell resources of Tuvalu. Report 400/86. South Pacific Commission, Noumea, New Caledonia.
- Pita, E. 1988. Country Statement — Tuvalu: Development of the inshore fishery resources of Tuvalu. Workshop on Pacific Inshore Fisheries Resources, South Pacific Commission, Noumea, New Caledonia, 14–25 March.
- Taumaia, P. & Gentle, M. 1982. Report on the Deep Sea Fisheries Development Project in Funafuti, Tuvalu. South Pacific Commission, Noumea, New Caledonia, 18 November–15 February.







PART 2  
*Human  
environment*

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# Population

## 6.1 Population: description and issues

### 6.1.1 General

There are many environmental problems described in this report. Most of the issues are the symptoms of humans putting too much stress on natural resources. In the health system there has long been criticism of the tendency of medical institutions to treat the symptoms rather than the cause of illness, and environmental protection is a parallel case. Too little is done to prevent problems and then much is required to rectify them. The pressure of a rapidly increasing population in an environment that can accommodate only a small total population is a cause of degradation. The symptoms might show up as fewer fish in the lagoon, polluted water and dumped rubbish, but the principal problem is the fact that there are now too

many people trying to live a lifestyle that requires more and more resources in an environment that is not capable of meeting that demand.

As with most environmental concerns in Tuvalu, there is a need to separate Funafuti from the other islands when discussing the impact of population growth. Although population growth rates are high across Tuvalu, considerable and continuing migration of people from the outer islands to Funafuti is leading to a situation where eventually it will not be possible to house, feed, educate or keep the population healthy. Population densities are currently over half those of Hong Kong. Unfortunately, unlike that colony, Tuvalu does not have massive economic power, strategic importance, or the large hinterland of mainland China to support high population levels. On the basis of its economic and environmental capabilities, Funafuti, and perhaps Tuvalu as a whole, is already beyond sustainable population levels.



*The need to retain significant patches of vegetation such as this will become critical as the population increases and more land is used for urban expansion. (photo: Alefaio Semese)*

### 6.1.2 Likely population growth

Tuvalu's draft ten-year Water and Sanitation Plan (Reynolds 1993) deals with the issue of population growth in some detail in an attempt to predict the facilities required to provide these essential services. Tables from that report are copied here to demonstrate the large increases in population that have been experienced in Tuvalu since 1979, and the forecast growth to 2002 based on two different assumptions (Table 6.1).

The key difference between the two forecasts concerns not the overall population levels expected in 2002 but the possible distribution be-

tween islands. The most pessimistic scenario (the second) would see the massive growth rates that have been experienced in Funafuti over the last three years continue. The 'natural' brake on this growth would be the fact that the more unpleasant and difficult life becomes in Funafuti (because of the pressures of overpopulation), the more attractive life in the outer islands will be.

It is wise to be cautious about all predictions of population change (for example, these figures do not include almost 1,000 Tuvaluans currently working outside the country). However, there is little evidence to suggest that any current programmes

**Table 6.1 Population forecasts from the draft ten-year Water and Sanitation Plan**

Forecast population: Scenario One*						
Island	Actual in year		Forecast for year			
	1979	1985	1991	1995	2000	2002
Nanumea	844	879	818	897	986	1024
Nanumaga	605	672	644	707	777	807
Niutao	866	904	749	822	904	939
Nui	603	604	608	667	733	761
Vaitupu	1273	1231	1205	1322	1453	1509
Nukufetau	626	694	756	829	911	946
Funafuti	2120	2856	3836	4209	4626	4805
Nukulaelae	347	315	370	406	446	463
Niulakita	65	74	75	82	90	94
Total	7349	8229	9061	9941	10926	11348

\*1985 Economic Plan forecast

Forecast population: Scenario Two*					
Island	Actual in year		Forecast for year		
	1979	1991	1995	2000	2002
Nanumea	844	818	810	800	796
Nanumaga	605	644	658	675	682
Niutao	866	749	714	672	656
Nui	603	608	610	612	613
Vaitupu	1273	1205	1183	1156	1145
Nukufetau	626	756	805	871	899
Funafuti	2120	3836	4674	5984	6606
Nukulaelae	347	370	378	388	392
Niulakita	65	75	79	84	86
Total	7349	9061	9911	11242	11875

\*Change based on 1979/91 actual.

Source: Reynolds 1993

or policies will prevent the large increases forecast. In fact, the current economic development practice and social trends are encouraging continued high rates of population growth in Funafuti. The question to be asked is whether the people of Tuvalu want a population of more than 6,000 in Funafuti in under ten years time and, as a consequence, a highly degraded environment.

Section 3.2.2 notes that the threat from climate change and sea-level rise is not so immediate as to require precipitous action. By contrast, the population growth issue is Tuvalu's most significant and immediate environmental problem, and some decisive action to change current trends is urgently required. The alternative is to experience a continuing downward spiral of environmental degradation and an ever increasing dependence on external economic support.

### 6.1.3 Implications for planning

Population control is a very sensitive issue in most countries. However, it is clear that more effort needs to be put into Tuvalu's current family planning programme. Non-government organisations such as churches and the Family Planning Association are often better placed than government to deal with this social issue, but programmes of this nature must be supported by government. Further, with population levels already too high on Funafuti, they can only be reduced by an active programme of providing incentives for people to stay

on or return to the outer islands. This is very difficult and will be achieved only if some of the facilities of Funafuti are provided to other islands. As the major attraction of Funafuti is paid employment, and because the biggest employer is government, decentralisation of government activities is likely to be the principal element of any such programme. The barriers to achieving a successful programme are high and establishment costs are also significant; nevertheless, urgent action is required.

Underlining any programme to reduce or relocate population is the need for an assessment of the population capacity of the islands. What should the population targets be, and where on each island should various land use activities be placed (urban centres and villages, animal feedlots, agricultural areas, commercial, office and industrial activities etc.)? While the pattern of human usage has to a large degree been shaped by traditional life, the need to make space for more people will mean that some activities, such as pig or chicken raising, may need to be relocated away from residential areas. Population and land use planning is an urgent requirement.

In addition, there may also be a need to establish building and occupation standards that set limits on the number of people able to be accommodated in houses of different sizes. For example, it could be determined through a building code that the maximum number of people permitted to live in a house with two rooms of average size plus



*With rapid population growth land is in short supply. These people are having to build over one of Funafuti's borrow pits. The pit is also used for rubbish and receives animal waste.  
(photo: Alefaio Semese)*

a kitchen area and toilet is five or six. A similar house with two toilets might be permitted to have eight residents. Such an approach is contrary to traditional Tuvaluan practice where any member of the extended family is welcomed into the house of a relative. However, the physical condition and capacity of Funafuti mean that some adjustments to current customs may be necessary. In the future, the same issues may apply to other islands with large populations.

## **6.2 Further reading**

- Booth, H. 1991. Tuvalu: A statistical profile on men and women. PMI/89/W01. United Nations Development Programme/United Nations Development Fund for Women, Pacific Mainstreaming Project, Port Vila, Vanuatu.
- Reynolds, C. 1993. Water and Sanitation Plan for Tuvalu for the Period 1993–2002. Draft report. Government of Tuvalu, Funafuti, Tuvalu.





# Education and information

## 7.1 Environmental education

### 7.1.1 Significance of education

Education is the key to improving the environmental conditions in Tuvalu. Human actions, mostly carried out in ignorance or without a full understanding of consequences, are the principal cause of almost all the environmental issues discussed in this report. Undertaking environmental protection programmes which are not backed by public education may solve the issue today but will not prevent its reappearance tomorrow. Like population growth, lack of education is a cause rather than a symptom of environmental damage. A review of environmental education has been undertaken and published separately to this

report. As a result, only a summary of the key points of an environmental education and information programme are outlined here.

### 7.1.2 "Education for Life" approach

While there is currently no formal environmental education programme in place in Tuvalu, the national education policy set out in the Medium Term Economic Framework Programme (Government of Tuvalu 1992b) has adopted a programme of "Education for Life" which aims to develop the country's human resources, improve the standard of living, and foster greater self-reliance. To fit with this policy, an environmental education programme must provide for education and training



Tuvaluan village. (photo: Alefaio Semese)

at all school levels, in the workplace through work and industry related training programmes, and in the community through community organisations and public information campaigns.

The environment, by definition, includes everything in our lives. It is therefore not a subject that can be isolated and 'taught'. At school environmental issues can be integrated into science and maths classes, social studies and other humanities subjects, and even into religious instruction. There are now teacher manuals and resource materials available from the South Pacific Regional Environment Programme (SPREP) to assist in the teaching of environmental issues. At work and in industry, programmes are also needed to show the effect of work practices on the environment, and to demonstrate new ways of working which reduce the impact of our work activities.

Special efforts will be needed to ensure that people engaged in subsistence activities in the fishing and agricultural sectors are provided with information about issues of importance to them. Amongst the general population, information programmes need to be developed to raise awareness about issues, educate people to understand the part they play in contributing to environmental degradation, and demonstrate what they can do to improve and protect their environment.

### 7.1.3 Specific issues

Other points that should be considered are:

- ◆ preparation of an environmental information and education plan by the Environment Officer;
- ◆ the need for information to be printed in Tuvaluan;
- ◆ establishment of a secure but accessible environment information and resource library so that the large amount of information currently available is not lost;
- ◆ special emphasis for environmental law enforcement such as special training for the police; and
- ◆ encouragement for the establishment of a community based conservation and environmental organisation.

## 7.2 Further reading

- Bektas, A. 1992. Review of Environmental Education — Tuvalu, 1992. South Pacific Regional Environment Programme, Apia, Western Samoa.
- Dunne, M. & Wendt, N. 1993. Environmental Education Teachers' Manual. South Pacific Regional Environment Programme, Apia, Western Samoa and Institute of Education, University of the South Pacific, Suva, Fiji.





*PART 3*  
*Economic*  
*and built*  
*environment*

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# Economic framework

## 8.1 Economic development programme

### 8.1.1 General description of economy

The Tuvaluan economy is a mix of subsistence and cash types. On the outer islands the subsistence economy is dominant, while on Funafuti the cash economy is of greater significance. The gross domestic product (GDP) is currently estimated to be less than \$13m per annum. Development programmes funded by international aid are progressively making the cash economy more important to the population. Unfortunately, Tuvalu's ability to sustain a cash economy without the support of international aid is quite limited. The internal market is very small and cash incomes for most of the population are at a low level.

Opportunities for the export of goods lie with the very small agricultural (copra), manufacturing (clothing) and fisheries sectors. While pelagic fish resources offer the best opportunity for an export industry, the only export income at present is derived from the sale of fishing licences to foreign fishing vessels. Minor export income is derived from the sale of stamps to collectors and handicrafts to visitors (most of whom are business visitors).

One significant 'export' is labour with the income returning to Tuvalu in the form of remittances. Sailors trained at the Maritime Training School work on foreign merchant ships and a significant group of Tuvaluans is employed at the Nauru phosphate mine (which is expected to cease operation by the end of the 20th century). The income from the Tuvalu Trust Fund is also a form of export income and is a critical contribution to the government's recurrent expenditure.

### 8.1.2 Government economic policy

The government's economic policies and programmes are set out in the Medium Term Economic Framework Programme, 1992–1994 (Government of Tuvalu 1992b). This document provides a context for development of the NEMS. It is essential that Tuvalu's economic and environmental strategies closely support each other, and it is preferable that they are integrated. The Economic Framework Programme states that the long-term economic and social objectives of the government are:

- (1) sustained long-term growth of the economy, without undue corruption of social or cultural values;
- (2) improvement in the distribution of income by diversifying the economic base, enhancing private sector initiative and improving infrastructure and increasing economic activity, without harming the environment; and
- (3) establishment of sound macro-economic policies and strategies within the public sector to direct and manage financial, economic and social affairs.

To support these objectives, four areas have been identified for strengthening:

- (1) economic development planning;
- (2) fiscal policy;
- (3) foreign and international relations; and
- (4) environmental conservation and protection.

### 8.1.3 Government environmental policy

Programmes proposed under the environmental protection policy area are:

- (1) to keep the issue of global warming on the international agenda;



- (2) to prepare a National Environmental Management Strategy;
- (3) to recruit an Environment Officer;
- (4) to establish equipment to monitor sea levels;
- (5) to undertake Environmental Impact Assessment for future development projects;
- (6) to improve management of waste through implementation of the Water and Sanitation Plan, and to encourage householders to recycle aluminium cans and plastics, and to compost organic waste;
- (7) to undertake a pilot project to fill the Funafuti borrow pits with sediment dredged from the lagoon (subject to Environmental Impact Assessment);
- (8) to continue the second phase of the coastal protection works project; and
- (9) to further train the Meteorological Division Scientific Officer on forecasting tropical cyclones.

The majority of these projects have been completed or are now being undertaken. Of great importance is the effectiveness with which the projects and practices proposed by the NEMS and the Water and Sanitation Plan are implemented and their momentum maintained. The small size of Tuvalu's economy and the limited number of skilled people available to undertake specialist activities makes environmental programmes vulnerable. The absence of a critical person (who may be out of the country), or the breakdown of equipment (such as the aluminium can press) can quickly undo many achievements. In addition, the desire to get development projects approved, funded and operational as quickly as possible leads to a temptation to ignore EIA processes. This may be compounded where the donor country or its aid agencies do not share a commitment to, or accept the importance of, EIA. This is a problem in all countries, but the lack of legislative power and the fact that assessment processes are new make Tuvalu more vulnerable than many other places.

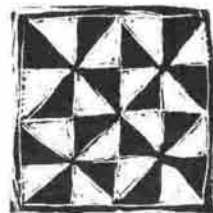
## 8.2 Economic development issues

Many of the issues relating to economic development are dealt with under the relevant sector discussions. The issues to be considered in this section relate more to matters of principle and broad economic planning. The key issue is to ensure the integration of economic and environmental planning and programme development. While the policy stated in the Economic Framework Programme identifies the need to promote economic development in an environmentally sustainable manner, the environmental protection programme is, in the main, broad and general. This is understandable given the limited extent to which an environmental programme has been developed to date. The most significant commitment in the current economic plan is the preparation of the NEMS.

The current Economic Framework Programme is nearing the end of its term. A vital opportunity now exists to develop the NEMS and the next economic plan concurrently, and to set up institutional arrangements which ensure full implementation of the environment protection and economic development programme. The current economic plan mentions use of the National Development Strategy Committee to take on this joint task. Coordination at planning officer level is also necessary to ensure full integration.

## 8.3 Further reading

- Fairbairn, Te'o I.J. 1993. Tuvalu: Economic Situation and Development Prospects. International Development Issues no. 29. Australian International Development Assistance Bureau, Canberra, Australia.
- Government of Tuvalu. 1992a. Country report for UNCED: Tuvalu. Report prepared for the United Nations Conference on Environment and Development by Tausasa Taalaki, Uentabo Neemia and Randy Thaman. South Pacific Regional Environment Programme, Apia, Western Samoa.
- Government of Tuvalu. 1992b. Tuvalu: Medium Term Economic Framework Programme, 1992-1994. Funafuti, Tuvalu.



# Infrastructure and industry development

## 9.1 Introduction

The Tuvalu Medium Term Economic Framework Programme makes clear the government's commitment to sustained, long-term economic growth and an improved distribution of income (Government of Tuvalu 1992b). While this is qualified by a commitment to minimise adverse effects on social, cultural and environmental values, the primary objective can most easily be achieved through an increase in physical development. Given the nature of the Tuvaluan economy this development will occur mostly through infrastructure development and improvement projects.

It is during the initial planning phase of these projects that environmental issues must be considered. Even programmes that might be considered beneficial to the environment, such as the Water and Sanitation Plan, could have potentially adverse impacts. For example, a sanitation system that relies exclusively on soakage pits and septic tanks could lead to an increase in the nutrient levels of inshore lagoon waters. High nutrient levels will have an adverse impact on an ecosystem which is an important food source for many people. Only a thorough Environmental Impact Assessment (EIA) and ongoing monitoring will provide sufficient information to determine whether a particular project will have adverse impacts, or whether the predicted impacts are acceptable because of other benefits resulting from the project.

This section examines the likely development sectors and comments on possible environmental issues that may have to be considered in the planning and implementation stage of related projects.

## 9.2 Water and sanitation

### 9.2.1 General

Since 1978, when Tuvalu became an independent nation, the priority given to the provision of water, sanitation and waste disposal facilities has increased. This is in recognition of the fact that in order to survive, be healthy, and enjoy reasonable well-being, Tuvalu's population requires:

- ◆ an adequate supply of water suitable for drinking, cooking, washing, commerce, industry and agriculture; and
- ◆ suitable methods for disposal of used water and other wastes to prevent the spread of disease either through direct contact with waste, indirect contact through the use of polluted water, or infection by flies, mosquitoes, rats and similar disease-spreading animals.

Disease outbreaks in 1985 and 1990 showed how the absence of these requirements led to a life threatening situation.

### 9.2.2 Future planning

Water and sanitation programmes have been an important feature of each of Tuvalu's economic development plans. A further dedicated water and sanitation plan for the next ten years is currently in draft form and awaiting government approval. The principles of the plan which underlie a recommended programme of works are the following:

- (1) water supply should be primarily provided by way of catchment tanks with a minimum supply of 50 litres per person per day. Groundwater supplies, where they are accessible, are not to be used as a primary supply;



Unmanaged rubbish disposal in borrow pits poses a potential health hazard on Funafuti. (photo: Alefaio Semese)



- (2) the minimum toilet standard is the provision of a 'pour flush' /soakage pit type latrine for each household (based on an average occupation rate of six). The use of septic tanks is recommended for households and is suggested as a requirement for commercial and similar developments;
- (3) animal waste from feedlots is not to be disposed of indiscriminately and preferably should be used as agricultural manure; and
- (4) strict land use controls are required over groundwater reserves which are utilised for domestic supply purposes.

### 9.2.3 Sewage disposal

There are a number of issues relating to sewage disposal that need to be considered in the development of the NEMS and the island land use plans. As discussed earlier, there is a strong possibility that nutrient levels in the inshore lagoon waters adjacent to the village area on Funafuti are already high and increasing. Two factors which probably contribute to this situation are the use of the beach area as a toilet, and the inflow of polluted groundwater caused by effluent from latrine soakage pits and septic tanks. Only a water monitoring programme combined with a study of the lagoon flushing regime will give an indication of the significance of this issue.

Increased nutrient levels will damage the marine ecosystem. Changes will take place as coral

and the marine animal species which depend on it are displaced by increased algal growth. This will not only reduce the human food supply but could also possibly increase the risk of an outbreak of ciguatera poisoning.

Pit latrines will eventually fill and new pits will be required. Where land is limited, such as on Funafuti, this may become a major constraint. Septic tanks in atoll environments, especially in built-up areas such as Funafuti, perform less effectively than they do in other places. Effluent drainage lines are short (because of small allotment sizes) and the nature of the soil, combined with a high water table, means nutrient-rich waste quickly enters the groundwater. In addition, sludge from septic tanks must be pumped out periodically. Suitable treatment and disposal arrangements are not currently available.

Reliance on a system where sanitation waste is disposed to the ground can effectively make groundwater resources unusable, particularly in built-up areas. This practice may conflict with uses which rely on this resource (such as 'pulaka' pits).

Alternatives may need to be investigated. Composting toilets (which require no water for flushing and produce quality agricultural fertiliser as a by-product) are one possibility. Such systems are being used in many locations in Australia, and an experimental system has been successfully established in the State of Yap (Federated States of Micronesia). If population growth continues on Funafuti at the current rate, a reticulated sewage

treatment and effluent disposal scheme may become necessary. Given the shortage of fresh water, such a scheme may need to be a salt-water system similar to that operating in Tarawa (Kiribati).

The use of the beach as a toilet remains a common practice throughout Tuvalu, even in Funafuti. This traditional method was suitable in past times where population size and densities were low. It is still an acceptable practice where such conditions continue to exist and where the ocean beach is used. In village areas and especially on Funafuti's lagoon beach, the practice could easily create conditions conducive to the outbreak of disease as well as adversely impacting on the lagoon ecology. The provision of suitable alternatives (perhaps by requiring two toilets per household) and adequate education are required to address this issue.

#### **9.2.4 Land use planning**

Animal pens (pigs and chickens) could create significant environmental problems as more feedlots are established. Adequate separation between feedlots and other incompatible land uses (such as housing) will be increasingly difficult to establish as human population densities increase. Effluent run-off from these activities may already be contributing to water pollution in Funafuti, as most feedlots are located on the banks of the borrow pits. In some instances, people also wash in these pits. Animal pens should not be located above groundwater resources which are used by humans, nor should animals (especially pigs) be permitted to free-range over these areas. Island land use plans are needed to ensure an adequate separation of incompatible uses.

### **9.3 Agriculture**

#### **9.3.1 General description**

Agriculture in Tuvalu operates mostly at the subsistence level. Cash crops are limited to a small copra production for the export market (which has been in decline in recent years owing to poor world prices) and small volumes of root and other vegetables sold on the domestic market. Animal products available on the domestic market are limited to chickens, eggs and pork. Small volumes of honey are also produced for the domestic market. The subsistence side of agriculture is very important.

The government's Medium Term Economic Framework Programme (Government of Tuvalu 1992b) notes that 80 per cent of the population is involved in agriculture. Coconuts are grown over about 70 per cent of all land suitable for cultivation, and for the most part the product is consumed locally by people and animals. Breadfruit, bananas and root crops ('pulaka', taro, sweet potato etc.) are also produced on a subsistence basis, and some individuals produce other vegetables. Tree species contribute significantly as a source of construction materials, and provide the raw material for the production of utilitarian and craft products.

The government's agricultural policies are to encourage greater production and diversification of products. The current objective for the agricultural sector is to satisfy at least 50 per cent of the nation's food needs while increasing the income-earning capacity of the sector.

#### **9.3.2 Main environmental issues**

The main environmental issues in the agricultural sector relate to:

- (1) increased use of agricultural chemicals and the disposal of used chemical containers;
- (2) disposal of waste generated by animal feedlots (discussed under the water and sanitation section);
- (3) the need to separate intensive livestock pens from incompatible land uses such as residential or commercial;
- (4) introduction of animal or plant species or diseases which may threaten existing species;
- (5) removal of coastal vegetation which, amongst other benefits, protects crops from damage caused by salt laden winds; and
- (6) threat from climate change which could affect crops by increasing salinity levels of the groundwater or by waves swamping agricultural crops.

Most of the agriculture-related issues interact with other sectors and possible solutions are discussed in those sections. One of the key requirements for maintenance of good agricultural practices is keeping incompatible uses separate. Intensive livestock pens and perhaps bee-keeping (if the industry expands) are activities which should maintain good separation from residential and commercial areas. Should agricultural development get to the stage where chemical usage



increases, these activities should not be permitted close to areas where people live. The development of land use plans based on the Tuvalu land resources survey is the key to minimising land use conflicts and the environmental degradation these can bring.

### 9.3.3 Agricultural chemicals

The possible increase in the use of agricultural chemicals is an area deserving special consideration. At present the use of chemicals is not extensive. A pest animal baiting programme was conducted in the late 1980s using chemical rodent baits. Government policy to expand and diversify agricultural production may lead to an increase in the use of chemical fertilisers and pest control agents. It has been commonly reported that transnational chemical companies 'dump' hazardous chemicals banned in developed countries on the markets of less developed countries. Tuvalu should not permit the import of chemicals banned in other countries, and should be conservative in encouraging agricultural products that are dependent on chemical input.

## 9.4 Development and the environment

### 9.4.1 General

Infrastructure and tourist related development has been, and will continue to be, a significant component of economic growth in Tuvalu. Even if industrial or resource based activities (such as

commercial fishing) expand significantly, the major infrastructure and industry development programmes will remain important for the provision of employment and inflow of capital. Development means not simply large, one-off projects but also includes incremental growth in all economic sectors. An increase in the number of motor vehicles and the volume and standard of construction (for example, of houses), the establishment of new businesses and expansion of existing ones, or a gradual increase in the number of tourists and business visitors are all examples of development. All development will have some impact on the environment. This impact may be large or small and may be positive or negative in effect.

Infrastructure projects tend to be moderate to large in scale and are constructed over relatively short periods, even if planned long before work begins. Because of their scale and the changes they can bring in the short term, it is often easy to see their impact on the environment. These projects do, however, have an advantage in that their effects can be assessed during the planning stage, and design changes made or protective measures taken to minimise adverse impacts.

### 9.4.2 Environmental Impact Assessment (EIA)

#### New projects

As a rule, Tuvalu has not previously required formal Environmental Impact Assessment (EIA) of major projects. An exception is the EIA being conducted in relation to a pilot dredging programme in Funafuti lagoon. In recent years, however, a range of



*Vaiaku Lagi Hotel. Donor-sponsored development such as this will provide a great economic boost to Tuvalu. However, such developments should be subject to Environmental Impact Assessment (EIA) to ensure they meet agreed building and environmental standards. (photo: Alefaio Semese)*



significant infrastructure projects have been undertaken without EIA. Examples include foreshore protection works, airport upgrading, a new hotel, and road construction. While these projects will be of economic benefit to Tuvalu, their impact on the environment may still have to be identified and dealt with.

A recent example is the Funafuti airstrip upgrading project (and the proposed extension) which required the use of large volumes of stone. This stone was extracted from the rock and rubble rampart on the ocean foreshore adjacent to the airstrip. From the airport project manager's viewpoint, it was a sensible economic and operational decision to use this 'free' and nearby resource. However, this stone also provided a significant level of foreshore protection and is a key part of the island building process previously described. Removing this protection leaves adjacent areas more vulnerable to inundation and erosion during extreme weather events. To reinstate the same level of foreshore protection as that offered naturally would require the construction of a large and very expensive sea wall. Environmental Impact Assessment and a full economic analysis of both the internal (project) and external (environmental) costs of the airstrip project would have provided an opportunity for the government to judge the full environmental and financial costs and benefits of the proposal.

Tuvalu is often at a disadvantage when development projects are planned as most are funded by international aid agencies. These agencies are always keen to keep project costs to a minimum and may wish to avoid an EIA which could be an expen-

sive undertaking in its own right and add costs to the project itself. In recent years, however, many donor countries have begun to recognise the necessity of conducting EIAs, and appreciate the long-term savings achieved if projects are designed to minimise environmental impacts in the first place.

During the development of the NEMS the requirement for an EIA process for major projects should be fully considered. A combination of appropriate legislation and agreements with donor agencies (or their governments) to include an EIA requirement for all proposals appears to be a necessary step for the government to take.

### **Auditing existing activities**

Environmental Impact Assessment is not simply an issue for consideration in new projects. Existing activities, especially those of public and private utilities, should be examined to measure their impact, or potential impact, and determine any necessary action. Environmental audits can be used to do this. For example, in Funafuti there are a number of enterprises that should have their current operations and practices audited. The most obvious candidates would be:

- ◆ the Public Works Department depot and stone-crushing operations;
- ◆ the BP terminal and depot;
- ◆ the port and fisheries wharf operations; and
- ◆ the Tuvalu Electricity Corporation powerhouse.

### **Impact of small-scale developments**

The importance of assessing the environmental impact of large projects or operations is evident.



*Funafuti BP terminal, where all of Tuvalu's bulk fuel is stored. In this vulnerable environment, it is important to ensure that facilities to cope with oil spills are adequate. (photo: Alefaio Semese)*

'The Fusi', Funafuti's main store. This is where Tuvalu's cash economy is most obvious.  
(photo: Alefaio Semese)



However, one should also reflect on the cumulative impact of multiple 'small-scale' developments. Examples might include:

- ◆ One pig pen on the banks of a borrow pit may cause little or no impact, but what is the effect when there are 20 side by side?
- ◆ One or two motor vehicles on a small atoll island will have a negligible impact. How many vehicles does it take before environmental problems start to become evident?
- ◆ A few people on an island eating mostly imported food is of little consequence, but what is the impact when, over a few short years, most of the population start eating imported food?
- ◆ What is the impact of unplanned expansion of urban and village areas?

These examples, and many more that could be described, are cited to highlight the potential environmental effects which can flow from many relatively small changes. Dealing with these incremental changes is perhaps one of the most difficult aspects of environmental management. This is because any one of the changes in itself has little effect, and also because these situations are more likely to involve an individual or family trying to improve their own material circumstances.

### 9.4.3 Land use planning

Part of the solution lies in planning ahead for these changes. This report has already mentioned the need for island land use plans which would identify areas for various residential, industrial and agricul-

tural uses so as to minimise conflicts between them. Building codes can also be used to ensure standards of construction are adequate, and design and siting requirements can prevent conflicts (for example, by preventing the construction in a new house of a toilet too close to a neighbour's kitchen or bedroom). Land use planning will be no easy task, especially on Funafuti, where conflict between existing uses is already evident and land availability is very limited.

The major factor is to maintain institutional arrangements, at either central government or island council level, to ensure standards are maintained. There is little point in having planning, environment or building control laws if they are not adhered to. The protection of birds in Tuvalu under the Wildlife Conservation Ordinance is an example of an existing law not being enforced, either because of ignorance or because no-one has the responsibility or resources to undertake the task, or because the law is unnecessary.

Incremental changes in other sectors are also difficult to deal with. The examples above of an increase in the number of cars or consumption of imported foods demonstrate this.

Looking further at the vehicle example, we can see that the impacts from a sharp increase in their number may include increasing the demand for fuel; increased air pollution; costs to the health system of treating people injured in traffic accidents; and the cost of disposing of unwanted and broken-down vehicles.

What options are available in this example? Nothing could be done (the option that is currently being followed), in which case the impact must be



addressed by the sectors most affected. (The Health Division has to increase its budget; the island council has to find the resources to dispose of dumped vehicles; and the population will have to suffer these adverse effects).

Alternatively, actions could be taken such as adding an environmental tax to both the vehicles and the fuel they use to discourage their use, preventing importation of second-hand cars to ensure the car disposal problems of developed countries are not 'exported' to Tuvalu, or requiring owners to dispose of their unwanted vehicles at their own cost and in a place and way satisfactory to the relevant authority.

#### **9.4.4 Summary**

In summary there are a number of actions that can be taken to address the potential impacts of continued development in Tuvalu:

- ◆ require all new and significant developments to be subject to EIA;
- ◆ advise aid donors that project funding must include a sum to adequately undertake EIA;
- ◆ environmental audits be undertaken of all

existing major industrial and utility operations;

- ◆ island land use plans and building codes be developed; and
- ◆ an examination of the environmental impact of 'incremental growth' be made, and a range of taxation, legislative, educational and institutional actions relevant to each activity undertaken.

### **9.5 Further reading**

Government of Tuvalu. 1992a. Country report for UNCED: Tuvalu. Report prepared for the United Nations Conference on Environment and Development by Tausasa Taalaki, Uentabo Neemia and Randy Thaman. South Pacific Regional Environment Programme, Apia, Western Samoa.

Government of Tuvalu. 1992b. Tuvalu: Medium Term Economic Framework Programme, 1992-1994. Funafuti, Tuvalu.



# Pollution

## 10.1 Introduction

Tuvalu at present does not have a significant or insoluble pollution problem, despite the volume and variety of solid waste dumped indiscriminately around Funafuti. Rapid changes currently being experienced from the large growth in population, increased availability of imported consumer products, and an increase in the number of industrial-type activities mean that the potential exists for a very serious problem to develop in the near future. This is especially true for Funafuti; nevertheless, each island is presently confronting the issue of pollution to some extent. This section will look at current and potential pollution issues in each of the environmental sectors — land, water, and air and noise.

## 10.2 Solid and chemical waste

Solid waste management is perhaps the most obvious environmental issue in Funafuti. It is certainly the most visible. It is also likely to become a significant issue on most islands in the future, even if it does not reach the scale of the problem on Funafuti. Solid and chemical wastes in Tuvalu have many sources and are made up from a range of products.

### 10.2.1 Household waste

Households generate the bulk of current waste, much of which can be seen in inappropriate places, or otherwise badly managed. The main constituents of household waste are:

- (1) food packaging including aluminium and steel cans, plastic and paper products;
- (2) vegetable material: much is composted in household gardens but significant volumes,



*Fuel storage at Funafuti power station. There is no bunding system to retain spillage and no established procedures for cleaning up any spill that might occur. (photo: Alefaio Semese)*

often consisting of larger material such as branches or tree limbs, are dumped with other household rubbish; and

- (3) household chemicals including discarded batteries, petroleum products, bleaches, detergents and pesticides.

Household rubbish is not a significant threat to the environment nor difficult to treat. Its major impact is visual, although there are some elements in the waste stream which should be treated carefully. The principal issue relates to the management of waste. Indiscriminately dumped waste and unmanaged (or inadequately managed) rubbish disposal areas become ideal habitats for pests such as rats and mosquitoes. The larger the populations of such pests, the greater the chance of the spread of disease.

Discharged batteries, both the household dry-cell type and the lead-acid type used in vehicles, boats and as part of solar power systems, are probably the most difficult household wastes to treat





*With a large number of borrow pits, there is no shortage of places to be used as landfills on Funafuti. Sensitive foreshore areas should not be used for indiscriminate dumping of rubbish. (photo: Alefaio Semese)*

and dispose of safely. The major cause for concern is the possible contamination of soil and water supplies, and long-term health problems caused by the build-up of metals such as lead and cadmium found in these products. Young children can also ingest these materials directly by playing with discarded batteries. Discarded crushed dry-cell batteries can be seen in the streets of Funafuti. The dangerous chemicals found in these products do not readily break down and often build up over time in the human food-chain.

Other household chemicals can also lead to a build-up of contaminants in the environment. Without adequate methods of disposal, chemicals such as petroleum products and unwanted pesticides (for example, rat poison) can pose a threat to human health, particularly in areas of high population density. Even commonly used products such as bleaches and detergents can cause problems if not disposed of properly and later ingested by humans or animals.

A growing waste management issue is the need to dispose of unwanted or broken household equipment and vehicles. Large numbers of motor vehicles and boats, many of which were second-hand when imported, have been brought into the country in the last few years. Other large household items including refrigerators, washing machines and electronic equipment are also beginning to become common. The harsh physical environment of atolls ensures that much of this equipment has only a relatively short life. These large, bulky and often heavy items pose a physical disposal problem: that is, where can they be dumped? Some such as refrigerators and certain electronic equipment also

contain small amounts of harmful gases, metals or other chemicals which can build up in the environment.

### **10.2.2 Agricultural waste**

Agricultural production is mostly undertaken on a subsistence basis, generally utilising traditional management techniques. As a result, and because of the tendency to recycle plant and vegetable matter, this sector does not produce a large volume of solid waste requiring treatment or disposal. The government's Medium Term Economic Framework Programme (Government of Tuvalu 1992b) proposes an increase in the volume and variety of agricultural products. Given the infertile nature of most soils in Tuvalu, this objective could possibly lead to an increase in the use of agricultural chemicals, both fertilisers and pesticides. Careful and conservative use of these chemicals can provide many benefits to the community. However, they can cause serious health problems if misused, or if unwanted chemicals or chemical containers are indiscriminately dumped.

### **10.2.3 Industrial and commercial waste**

Industrial and commercial activities are often sources of large volumes of waste (such as paper products and containers), specialised waste (such as oil and petroleum products and other chemicals), unwanted heavy equipment (such as vehicles and engineering plant, electrical transformers etc.) and chemical drums. The operational practices of some industrial activities are already causing pollution of the environment, while others are potential



sources of pollution through accidental discharge of stored material. There is a need to examine the operations and practices of the major industrial activities in Tuvalu in order to assess the current and potential threats to the environment, and to propose both the physical works and operational changes necessary to remedy current problems and minimise potential impacts. On Funafuti, operations that should be examined in the short term include:

- ◆ airport operations;
- ◆ BP's Funafuti terminal
- ◆ hospital waste disposal arrangements;
- ◆ port operations (fuelling, bilge pumping, waste disposal, fish processing etc.);
- ◆ powerhouse operations; and
- ◆ Tuvalu Cooperative Society waste disposal arrangements.

## 10.3 Water pollution

### 10.3.1 General

Most of the issues relating to water pollution have already been considered under either water and sanitation (Section 9.2) or marine environment (Chapter 5). In brief, the key water sources to be protected from pollution are the domestic supplies (personal and community tanks and also groundwater supplies on some islands), groundwater supplies which are used for agricultural purposes, and marine waters (with special attention to lagoons).

### 10.3.2 Domestic and groundwater supplies

Major threats to the quality of tank water sources include dirty roof catchments and gutters, poor filters on tank inlets, absence of taps (requiring people to dip buckets into the supply itself), and lack of (or irregular) cleaning of the tanks themselves — in essence, inadequate maintenance.

Groundwater sources are most threatened by effluent from sewage disposal systems; contamination from waste dumped on areas where water is drawn (this includes leachate from solid, chemical and biological wastes); and through the impact of animals (particularly pigs) free-ranging over groundwater supply areas. A further potential impact is that of excavations in groundwater areas. Salt-water intrusion is also a significant threat and is likely to be one of the first effects felt from any significant rise in sea levels. Salt-water intrusion also occurs during periods of low rainfall.

### 10.3.3 Marine waters

Pollution to the marine environment can be caused by sewage effluent and contaminated water draining from rubbish dumped on the foreshore. In addition, an increase in turbidity can harm the marine environment. This may result from drainage of land, physical works in the marine environment (dredging, blasting and port development), and physical works on land which result in high sediment loads flowing into near-shore areas. Discharges from boats (bilge and ballast water discharge, solid waste disposal, fuel leaks etc.) and



*Back door of Funafuti Power Station. Oily wastes are simply hosed out the door, and drain away into the groundwater below. Managing oil waste is one of Tuvalu's most urgent pollution issues. (photo: Alefaio Semese)*



*Funafuti wharf is the main storage area for all goods brought into Tuvalu, including chemicals and petroleum products. The wharf is located on a very narrow part of the island, and any liquid spillage will quickly flow into the sea.  
(photo: Alefaio Semese)*

chemicals from the paints used on the hulls of boats to discourage marine growth can also pollute the marine environment. This is especially an issue in ports and areas such as lagoons where natural flushing may be limited.

## **10.4 Air and noise pollution**

### **10.4.1 General**

Air pollution is not a significant issue in a general sense in Tuvalu, but there are situations where some individuals may be affected. Some of these impacts will be a simple nuisance (such as the smell from animal feedlots located too close to houses). Others could, however, lead to an increase in eye or respiratory system diseases. The most significant and immediate problem is likely to be caused by prolonged exposure to cooking fire smoke and fumes from kerosene stoves where these exist in poor or unventilated areas. Chimneys or flues in kitchens could solve this problem.

### **10.4.2 Vehicle exhausts**

A growing concern on Funafuti is air pollution caused by vehicle exhausts. Many vehicles are poorly maintained, and exhaust gases contain poisons such as carbon monoxide and other uncombusted hydrocarbons (fuel and oil). In concentration, such as in village areas where air circulation may be limited, these gases are a source of long-term health problems. The rapid increase in the number of vehicles in recent years (a by-product of a rapidly increasing population and the

growth of a cash economy) may lead to air pollution becoming an important issue in Funafuti in the future. Standards requiring well maintained vehicles would alleviate some concerns, but limiting the number of vehicles may have to be considered in the long term.

### **10.4.3 Noise pollution**

Noise pollution sources in Tuvalu are limited and noise levels are low compared to most other places with similar or even lower population densities. However, the high urban and village population densities mean that noise could become an issue in some circumstances. Noise from industrial processes, vehicles and aircraft is the biggest potential problem.

On Funafuti, vehicle noise is likely to become the biggest source of public annoyance. The rapidly growing number of motor vehicles, many in poor condition, may become an issue of concern. However, it could be easily solved by the setting and enforcement of appropriate vehicle noise limits.

Aircraft noise is high, particularly around Vaiaku, but limited by the infrequent movement of aircraft. However, further residential development should not be encouraged close to the terminal area.

Most industrial operations likely to generate noise (the powerhouse, Public Works Department depot and the port area) are fortunately well located away from residential and commercial areas. Island land use and development plans should maintain this separation for new industrial activities.



The Public Works Department depot is one of a small number of industrial plants which should be subject to environmental audit. (photo: Alefaio Semese)



## 10.5 Pollution and waste management

### General

It often seems inevitable that in most societies pollution and waste management systems are developed only after serious cases of pollution have become evident. Fortunately, Tuvalu does not yet have a serious pollution problem and has the opportunity to address current concerns and prevent future ones from emerging. Even its current concerns are mostly restricted to Funafuti. Key areas requiring immediate attention are:

- ◆ solid waste disposal;
- ◆ petroleum waste management; and
- ◆ water quality monitoring (marine and groundwater).

Part of the NEMS must include a set of integrated projects to address waste management and pollution mitigation and control. Not all of these projects will require new resources. Rather, they may simply require a change of management practice or an attempt to modify community attitudes. The components of a waste management programme are likely to include the following.

### Education

Convincing people through education to stop disposing of waste indiscriminately, reduce the amount of waste they produce, and recycle wherever possible is the best method of waste management.

### Recycling and reduction of waste

Reducing waste volume is a key factor in making the waste disposal task simpler. Possible actions include:

- ◆ recycling and separation of waste at source, particularly bulky materials such as vegetation and paper products which can be composted (with a wood chipping service for branches etc.);
- ◆ recycling of aluminium cans (a scheme has already been shown to work in Funafuti);
- ◆ recycling of other products such as glass and oil where viable;
- ◆ crushing waste before disposal to reduce its volume;
- ◆ encouraging people through education to buy products with a minimum of packaging or to use foods grown or caught rather than bought;
- ◆ replacement of dry-cell batteries by rechargeable units and a solar powered recharging unit not only helps protect the environment but is more economical in the long run;
- ◆ taxation or container deposit schemes can discourage the purchase of throw-away packaging, ensure its return for proper disposal, and provide a revenue source to fund waste management operations; and
- ◆ additional taxation on 'environmentally unfriendly' products (such as disposable batteries) or reduced taxation on 'friendly'

products (such as solar powered electrical equipment) can encourage less waste and pollution.

SPREP should be asked to monitor relevant literature and provide information about recycling materials. Many products (such as plastics) can now be recycled whereas they could not a few years ago.

### **Landfill**

The establishment of dedicated, managed and secure landfill site(s) on each island is essential. The sites should be chosen from a range of options following a full assessment of environmental impacts and the most appropriate funding and management arrangements. On Funafuti a range of borrow pits provide a large number of choices, although dredged sand from the lagoon may be the only source of material to cover the waste. On other islands, pits could be excavated at landfill sites with the soil retained to cover the waste.

The provision of dedicated landfill sites must be backed by a collection scheme to which every household must belong and contribute financially, and which provides frequent and regular collections and efficient, thorough management. Although legal responsibility for waste management currently lies with island councils under the Local Government Ordinance, they generally have limited financial, technical or managerial ability to undertake this complex task. Other options which could be investigated are the use of private contractors or the Public Works Department.

### **Petroleum waste**

Petroleum waste should preferably be collected and exported for recycling, however, the feasibility of this proposal would first need to be investigated. In the short term, incineration at a location well away from habitation may provide a better solution than the current ground disposal method.

### **Hospital waste**

The current method of burning medical waste in a pit behind the hospital or dumping it with domestic waste must be replaced by incineration in a plant designed for the purpose.

### **Chemical waste**

Batteries and hazardous chemical waste for which incineration or landfill is not an acceptable method

of disposal should be collected and securely stored. For example, batteries can be stored in 200-litre steel drums and left under cover in a secure compound such as the Public Works Department depot.

### **Sea disposal**

Disposal of waste at sea is commonly practised and often criticised. In many places where waste volumes are huge and land based disposal options limited, it is used simply because it is seen as the cheapest disposal method.

However, there are circumstances where it is an acceptable disposal option. Sea depths around Tuvalu are great. Within a few kilometres of many of the islands the sea is up to 4,000 m deep. At these depths the water temperature is close to 0°C, water circulation is very limited, and there is very little life.

The capacity of the deep ocean in Tuvalu is much greater than that of its limited land area and may provide a better location for the disposal of some types of waste such as heavy machinery (old vehicles, engineering plant and equipment, old shipping containers etc.). Properly contained chemical wastes may be more appropriately dumped at sea than on land. However, this waste disposal option is only suggested because of lack of other alternatives. Chemical wastes should be first immobilised by fixing with cement, for example, drummed batteries would be filled with cement before disposal.

### **Monitoring**

As part of an overall environmental monitoring programme, a regular check of critical indicators relating to waste management and pollution should be made and reported.

## **10.6 Further reading**

- Aalbersberg, W. & Hay J. 1992. Implications of Climate Change and Sea Level Rise for Tuvalu: Report of a Preparatory Mission. South Pacific Regional Environment Programme, Apia, Western Samoa.
- Reynolds, C. 1993. Water and Sanitation Plan for Tuvalu for the Period 1993–2002. Draft report. Government of Tuvalu, Funafuti, Tuvalu.





*PART 4*  
*Managing*  
*the environment*

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# Government administration

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## 11.1 Introduction

The organisation of government is a significant element in the management and protection of the environment. Government has a central role to perform in environmental management. In Tuvalu, this role can be summarised as:

- ◆ establishment of environmental policy and coordination of environment programmes;
- ◆ law enactment and enforcement;
- ◆ provision of technical skills and standards;
- ◆ resource allocation between functions; and
- ◆ provision of public education and information.

Responsibility for environmental management and protection in any country is spread across a wide spectrum of government agencies. One of the biggest challenges is to coordinate these responsibilities so that environmental management is effective, resources are spent effectively and on agreed priorities, and duplication of effort is eliminated. The principal purpose of the NEMS process is to enable the Government of Tuvalu to establish its environmental priorities and to provide a basis for allocation of resources and responsibility across the government sectors.

The purpose of this section is to outline the current structure of government in Tuvalu, identify which groups have responsibility for different environmental sectors, and describe coordination arrangements between them.

## 11.2 Structure of government

### 11.2.1 General

Constitutional and statutory government in Tuvalu operates on two levels. The central government

consists of Parliament, the Executive (the Prime Minister and the Ministers supported by the public service) and the Judiciary. At the local government level, there are eight island governments (island councils), one for each island (except for Niulakita which falls under the responsibility of the Niutao Island Council). These councils are formed under the Local Government Ordinance and therefore have statutory status but not any independent constitutional status.

Traditional government is still important in Tuvaluan society with an island chief playing a major role in determining the pattern of communal activities. This system operates on an informal and non-statutory basis. It is often expressed through membership of island councils and through the influence of churches on the lives of most people.

With the inclusion of the Parliament and the Office of the Governor General, there are thirteen administrative units within the central government's administrative structure. Most of these organisations have some role in management and protection of the environment, or their programmes make an environmental impact. The approved budget for 1993 for all government agencies was about \$8.1m funded from the Consolidated Fund (government revenues) and \$7.9m provided from aid funds (international funds).

In governments around the world, the fragmentation of government responsibility throughout separate public agencies makes the integration of environmental management a more difficult task to perform. Public agencies need to accept that, no matter what their primary function, their activities should be assessed for environmental impact.

This seems to be a perfectly accepted principle in financial management (even environmental agencies must be managed according to agreed

standards), but not one which is universally accepted in regard to environmental standards. This separation of responsibility also restricts information sharing and transfer between the sectors of government.

### **11.2.2 Key public agencies**

In Tuvalu, the key public agencies and their environment related functions are the following.

#### **Office of the Prime Minister**

This office provides support to the Prime Minister and a number of coordination and support services for other government sectors. The Office of the Prime Minister provides support to three key government policy and priority setting groups: the Cabinet, the Development Coordinating Committee, and the National Development Strategy Committee (yet to begin functioning at the time of writing). Two other functions of relevance in this office are the Training Coordination Section and the Broadcasting and Information Office.

#### **Office of the Attorney General**

The Attorney General is the principal legal adviser to government and conducts legal proceedings on its behalf. This office prepares legislation and has significant responsibility in relation to the government entering into international agreements (such as the SPREP and climate change conventions).

#### **Ministry of Foreign Affairs and Economic Planning**

In addition to foreign policy, this ministry is responsible for economic planning and statistics. The Economic Planning Section has an important role in capital and infrastructure project assessment. This assessment is intended to include an analysis of the potential environmental effects of these projects. However, staff generally have an economics background and lack relevant environmental assessment experience or qualifications. This issue is compounded as most of the projects are proposed by groups who similarly lack environmental assessment experience.

The Statistics Section is responsible for collection and publication of census and other data, and could provide a valuable service in the collation of environmental statistical information. Little information is currently available, although groups such as the Health and Fisheries Divisions do collect information of significance to environmental

management. The implementation of an environmental monitoring programme would produce a range of information which could provide the basis for an annual report on the environment.

#### **Ministry of Finance**

The Ministry of Finance is responsible for the government's budget and financial management including taxation, excise and tariff policy. This ministry could develop a role in environmental management through the setting of differential taxes and charges in a manner which complements environmental protection policies.

#### **Ministry of Trade, Commerce and Public Corporations**

This ministry is responsible for promotion of commercial, private sector development and the corporatisation of public agencies. Specific responsibilities of relevance to the environment sector include tax reform, promotion of tourism, and promotion of import substituting industry.

#### **Ministry of Labour, Works and Communications**

This ministry is responsible for the provision and management of a wide range of infrastructure and services. These include telecommunications, meteorology, shipping and civil aviation. The Public Works Department provides technical advice, project planning, design and construction services for infrastructure management and development. This includes water and sanitation, airfield, jetties, boat channels, roads and public buildings. All of these functions can have an impact on the environment. This ministry should have a critical role in monitoring and protecting the environment, and in ensuring that the impacts of project proposals are adequately assessed. This potential role has added importance given the current absence of EIA requirements or an environmental protection agency to carry out this function.

#### **Ministry of Health and Human Resources Development**

This ministry is responsible for the government's social services programme covering health and education, and its policies are critical to providing environmental protection in the long term. In Tuvalu, the two principal causes of environmental degradation are the pressure of population growth and a general lack of knowledge amongst individuals



of the impact of their actions. The Health Division is responsible for the government's population policies, and the Education Division is responsible for the "Education for Life" programme. A wide range of resource material is now available from SPREP to assist teachers in the presentation of environmental education. Introduction of environmental protection objectives into both these programmes is essential.

### **Ministry of Natural Resources and Development**

This ministry is responsible for development of the fisheries, agriculture and minerals sectors. These sectors have been discussed in some detail previously in this report. Clearly, this ministry's programmes have an impact on environmental values and are critical to the people of Tuvalu for the provision of the majority of their food needs. Its programmes have a resource production rather than a resource conservation orientation. While this approach is generally common to primary industry organisations all over the world, in other countries there is usually an environmental protection organisation to provide a balance. There is a concern that not enough effort is being applied to environmental research, impact assessment or resource conservation by Tuvalu's resource development agencies. This is of concern in two particular areas: the lagoon and reef fish resources, and the provision of stone and earth resources for development projects. Both issues are of major significance on Funafuti.

The Environment Officer who was previously employed within the Office of the Prime Minister is now located within the Ministry of Natural Resources and Development. The relocation of this position reflects the importance being placed on integration of resource production and resource conservation in an attempt to undertake development of natural resources on a sustainable basis.

### **Ministry of Home Affairs and Rural Development**

This ministry is responsible for the government's local government, rural development, community affairs, and lands and survey programmes. These programmes aim to facilitate rural development with the objective of slowing the rate of rural migration to Funafuti. The Lands and Survey Division can play an important role in environmental monitoring and planning as it provides much of the base

material and skills necessary for mapping and assessment work.

### **Police and Prison Services**

The Police Service ensures law and order throughout Tuvalu. It can fulfil an environmental law enforcement role, provided officers are educated in the provisions of Tuvalu's environmental laws. At present these laws are limited and, through ignorance, not fully enforced.

### **11.2.3 Local government**

The island and town councils of Tuvalu have a legal responsibility for a very wide range of community services. The local government legislation enables, but does not require, councils to undertake environment related functions such as:

- ◆ activities related to agriculture, livestock and fisheries;
- ◆ building control and land use planning;
- ◆ education;
- ◆ trees and forestry responsibilities;
- ◆ land protection;
- ◆ famine and drought relief;
- ◆ public health and water supply;
- ◆ communications and public utilities; and
- ◆ control of commerce and industry.

With a total annual grant from the government of only \$40,000, little ability to raise funds from other sources and almost no staff, local government is much constrained in carrying out these functions and generally does not perform them. They are, however, well placed in the community, and are legally entitled to undertake the whole spectrum of environmental protection and land use planning work.

### **11.3 Coordination of environmental management within government**

Responsibility for management of the environment is spread right across government. While some agencies have direct legislative responsibility for one sector or another, there is no overarching legal basis for coordinating this function. In recent times the government has begun to address this issue through the appointment of an Environment Officer, and by making a commitment to the



preparation of a National Environmental Management Strategy. In addition to these actions, the government now requires project proposals prepared by ministries to report on the likely environmental implications of their plans.

Coordination and independent assessment of major policy and development proposals currently occur at three stages. Firstly, planning staff in the Economic Planning Division of Foreign Affairs and the Ministry of Finance assess the proposals, and any which they believe have potential impact on the environment are referred to the Environment Officer. Secondly, the Development Coordination Committee reviews proposals before they are considered by Cabinet. Once through this process, the proposals are incorporated into the budget-building process or are taken to the aid organisations for funding.

Members of the Development Coordination Committee include the secretaries of each Ministry and the Director of Economic Planning. This Committee has a wide range of responsibilities for coordinating government business and providing advice to Cabinet. This process is very worthwhile, provided those projects which are considered to have a likely impact are subject to an appropriate degree of environmental assessment before they are finally considered.

#### **11.4 Environmental management issues**

Resources available for government administration are extremely limited. Government priorities in the past have tended to concentrate on economic development without much emphasis being placed on environmental management. Clearly, this situation has now changed. However, the structures of government including the legislative base, the way in which proposals are developed, and the exper-

tise of the people making project assessment still generally reflect previous trends. The NEMS process provides an opportunity to review and change these management arrangements to reflect the government's current policy.

A change towards high quality environmental management in Tuvalu is not dependent on a detailed strategy, new projects, changed legislation or even the acquisition of new skills. Given the considerable extent to which the public sector dominates the economy in Tuvalu, change simply based on adoption of new policy can begin to occur. For example, while EIA legislation is desirable, a simple decision by the government could ensure that all major public projects (which would mean most projects in the country) are subject to environmental assessment. Such a practice could become a common condition on the acceptance of international development assistance. Similarly, public bodies who undertake the vast majority of development activity in Tuvalu can be directed by government to do their work according to sound environmental management principles.

The framework already exists for a high level of management. What is presently missing is a heightened environmental awareness in people who manage government responsibilities and make decisions. An information and awareness campaign directed at the staff of public bodies, together with a comprehensive government policy statement backed by an appropriate direction to public agency managers, would go a long way toward ensuring that development activities and management practices in Tuvalu were placed on a sound environmental basis.

#### **11.5 Further reading**

Government of Tuvalu. 1993. National Budget Papers. Funafuti, Tuvalu.



# Land tenure

## 12.1 Land tenure: overview

### 12.1.1 Traditional tenure

In Tuvalu, land is a treasured possession for each family, and land ownership rights are carefully protected. Land tenure and ownership arrangements are relatively complex and, essentially, continue to maintain the traditional system, even though in more recent times a Western style land register has been established based on a cadastral survey. In the main, land is transferred through the inheritance system although it is sometimes gifted or exchanged. Through this system, land holdings tend to stay under the management of extended families. Traditionally, land plots extended the width of an islet in relatively narrow strips. This practice ensured that each plot contained a range of soil types and qualities and prevented a situation in which an individual holding consisted of either all high quality, or all low quality, land.

### 12.1.2 Contemporary changes

With a large and rapid increase in population and continued distribution of land to children through inheritance, this traditional tenement pattern has been substantially modified. Today, the pattern is generally one of very small and irregular allotments which are legally registered in the name of one person although many people may have a traditional claim to it. Because of this situation, many plots are managed together as part of a family's total land holdings. Traditional ownership arrangements have been further complicated in recent decades by more intermarriage and migration between islands, and employment in the cash economy. Many owners can no longer manage their land directly. Alternatively, because of migration, many people no longer have access to land on the island

on which they live. This is most evident on Funafuti where many people hold land under lease or are landless.

Communal land is also a feature of the islands. Communal land may have had that status for all time, it may be new land that has resulted from accretion or reclamation, or it may have traditionally belonged to a village chief for his personal use but become communal land with the change to statutory government. Communal lands are traditionally used to provide food for families in times of hardship when food produced from their own land is not available. Island councils are responsible for the management of communal land.

Significant areas of land are now leased by the government or island councils and used for public purposes. This is a particular feature of Vaitupu and Funafuti. On the latter atoll, the government occupies about 25 per cent of the land area (a substantial part of this area being taken up by the airstrip).

### 12.1.3 Main issues

In the country report to the United Nations Conference on Environment and Development (UNCED) (Government of Tuvalu 1992a), the government maintained that land shortage, landlessness and land alienation are among the main constraints to sustainable development, whether economic, social or environmental. Land and marine resources are the only factors which will protect Tuvalu from increasing vulnerability to instability in the world economy. This report has previously discussed the need for land use plans for each island. While such plans cannot address the question of land distribution and landlessness, they can prevent many of the environmental concerns that arise when people attempt to carry out activities

inappropriate to the location because they lack access to more appropriately located land.

## **12.2 Further reading**

Government of Tuvalu. 1992a. Country report for UNCED: Tuvalu. Report prepared for the United Nations Conference on Environment and Development by Tausasa Taalaki, Uentabo Neemia and Randy Thaman. South Pacific Regional Environment Programme, Apia, Western Samoa.

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# Environmental law



## 13.1 Environmental law: overview

A separate report on environmental law in Tuvalu has been prepared following a review undertaken by Mere Pulea from the University of the South Pacific, Vanuatu and David Farrier of the University of Wollongong, Australia (Pulea & Farrier 1994). Because this comprehensive review has been undertaken separately, this State of the Environment Report will not be covering the legal sector in any detail. However, for the sake of completeness, the main laws of Tuvalu relating to environmental management and protection are listed in Appendix 2.

There is considerable scope for improving the environmental laws of Tuvalu and, in particular, for introducing laws requiring the application of Environmental Impact Assessment for major projects. Given existing laws, land use powers available to island councils (under the Local Government Ordinance) and the ability of the government, through policy direction, to require adherence of most development to acceptable environmental standards, there is plenty of scope at present to achieve sound management objectives. Therefore, law reform does not need to be a high priority on the government's environmental management agenda.

## 13.2 Role of island councils

The one exception to this general statement relates to the ability of island councils to undertake the land use and environmental management functions available to them under legislation. It is clear that the councils do not have the capacity — in terms of either human or financial resources — to exercise these responsibilities. In any case, if each council did have these resources, there would be an oversupply of them on a national basis. The government should therefore consider modifications to the Local Government Ordinance to enable an alternative approach: for example, the government could take on these responsibilities itself. Alternatively, the government (or donors) could provide human and financial resources to undertake planning and enforcement work and utilise each council as a type of 'planning and environment commission' which would be responsible for decision making.

## 13.3 Further reading

Pulea, M. & Farrier, D. 1994. Environmental Legislation Review — Tuvalu, 1994. South Pacific Regional Environment Programme, Apia, Western Samoa.





# Environmental monitoring

## 14.1 Introduction

Most people conduct some type of monitoring programme in their everyday lives, even if it is not a conscious or planned activity. People monitor their own and their children's health, water tank levels, the amount of food in the house, the changing prices of common foods or the amount of money in their pockets. At work and in business, monitoring is a way of life. For instance, the levels of stock are checked so that reordering takes place before a product runs out.

Monitoring of the environment is not such an automatic or common practice. Part of the reason for this is the diversity of environmental issues and the split of responsibility between sectors. Some sectors are monitored well, such as weather. Others are not monitored at all or to an inadequate degree. Even where monitoring of the environmental sectors is good, the information is rarely brought together, analysed and reported in a comprehensive manner.

Without a monitoring programme, it is more difficult for corrective action to be taken to prevent the impact on people that a degenerating environment will have. In some sectors, such as the marine environment or with water quality, the effect of degradation is not generally obvious until it is almost too late. For example, by the time people notice that fish from a particular source (such as a lagoon) are no longer being caught in the necessary quantities, the actual population of the fish species in that locality may be smaller than that needed to enable it to recover naturally. Monitoring is the tool which assists in the prevention of environmental degradation. Preventing a problem is much better than curing one.

While monitoring is not commonly conducted in all environmental sectors in Tuvalu, the nation

has a special need to do so. That relates to the limitations of the environment and the dependence of Tuvalu's growing population on it. It is the capacity of the environment to continue to provide the basics of food and shelter in a predominantly subsistence economy that will determine the material well-being of the people in the future. The characteristics of Tuvalu which make a comprehensive monitoring programme achievable are its small size and the limited number of sectors that need to be examined. Environmental monitoring is a less complex task here than in larger, more diverse places.

## 14.2 Monitoring programme development: key factors

In developing a monitoring programme, a number of factors must be considered.

- (1) Information needs to be accessible. There has been a lot of information prepared about the environment in Tuvalu in the past, but much of it is scattered, unavailable within the country, or in a form which cannot be easily understood.
- (2) Information collected at a point in time is static, only a 'snapshot' of the issue. Monitoring, on the other hand, is all about measuring, observing and analysing change. A programme will need to permit the collection of information over time.
- (3) Collecting, analysing and publishing information can be time-consuming and expensive. To minimise the effort, only critical sectors should be included in the programme. Above all, it must be practicable and achievable with available resources.

- (4) Some monitoring will require specialist skills and equipment. In some cases local people can be given the necessary training, but in other cases it is more appropriate to use external expertise. Much monitoring is simply a matter of observing common activities or situations on a regular basis, recording the information and looking at the changes.
- (5) Environmental monitoring is not the task of one person or one sector. To be effective, the government needs to identify a focal point to edit and publish information gathered and analysed by others.

### 14.3 Sector monitoring

#### Land

There are a range of features to monitor on land which can indicate the health of the environment. While some of these require specialised equipment, others can be examined by simple observation. The following would be some key features to monitor.

- (1) *Water quality, including surface water, community tanks and groundwater.* Water quality testing requires the use of electronic testing equipment. In Tuvalu, monitoring of water quality should generally concentrate on signs of contamination by biological, particularly human, wastes. In built-up or industrial areas, signs of petroleum product contamination should be monitored.
- (2) *Vegetation coverage.* This is a good indicator of change. With limited training an observer can calculate the change in vegetation cover from air photographs taken at regular intervals of time. At present the Lands Division has photos taken in 1973–1974 and 1984. A ten-year gap may be too large in Funafuti where change is rapid, but it is an adequate time span for much of Tuvalu. An alternative approach is to establish a series of transect lines at various points across an islet. At regular intervals the observer walks the lines recording the number and types of species encountered.
- (3) *Coastal foreshores.* These are naturally prone to change. Identifying sections of coast vulnerable to erosion, and then using either

air photos or ground-level photos taken at regular intervals to monitor change, is a relatively simple technique.

- (4) *Solid waste pollution.* This can be monitored by photographing selected sites at regular intervals and comparing the change over time. The changing products that make up the waste can also be monitored.

#### Marine environment

- (1) *Fish catch and consumption studies.* These can be carried out by a simple survey technique. Measuring the change in fish catch by time spent fishing can be an indicator of environmental health.
- (2) *Fish stock and marine habitat surveys.* These surveys are more complex in terms of techniques and analysis. They would only be necessary in heavily fished areas; to monitor a specific feature such as ciguatera or the impact of works undertaken in marine areas; or in other similar circumstances.
- (3) *Water quality and circulation patterns.* Such aspects should be monitored in a lagoon like Funafuti where visual observation shows that human wastes may be polluting the water, and where the shape of the island may restrict the exchange of water during changes of tide.

#### Climate change

- (1) *Climate.* Climate involves very complex systems, and change occurs over vast time spans. Tuvalu's weather records and its tide monitoring station contribute with information from many places to establishing the pattern of climate change. The remoteness of Tuvalu from other monitoring stations makes the information gathered here particularly valuable.

#### Population and health

- (1) *Population and health information.* This information is vital for economic and social service planning. The information can also be used to relate changes in the environment to changes in demographics or health. Much of this information is already collected through the census and hospital records.

#### Education and information

- (1) *Record keeping.* Keeping a record of education



and information programmes helps determine their effectiveness and identify areas which may require greater effort.

#### **Development trends**

- (1) *Industrial and public utilities monitoring.* Tuvalu does not have industries or utilities which emit effluent requiring complex and technical monitoring equipment. Regular monitoring of their operations and measurements of their waste products (for example, how much waste oil is produced or the volume of animal waste), together with reviews of the means of waste disposal, can be useful indicators of the need for action.
- (2) *Other development indicators.* Other indicators of value might be the volume of petroleum consumed or the number of vehicles registered.

#### **14.4 Reporting on the environment**

The purpose of a monitoring programme is to provide early warning of the signs that might indicate that something has changed in the environment. Monitoring on its own serves no purpose. The real objective is to be able to analyse data and publish information that can be used to make planning, policy and operational decisions. For this reason, a monitoring programme must include a system of storing and retrieving information that is simple, accurate, longstanding and able to survive the inevitable change of staff in any organisation.

Methods of reporting also require thought and planning and an understanding of who will read the report. An annual report of key indicators may be appropriate in Tuvalu to ensure critical sectors of the environment are regularly studied. However, the managers of each sector may need more detail to assist them to plan and set programmes.







*PART 5*  
*Priority*  
*programmes*

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# Priority programmes and projects

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## 15.1 Introduction

In each of the sections of this report environmental issues have been discussed in the context of possible actions that can be taken to address them. Taken together, the list is long and many of the tasks complex, with some likely to achieve their objectives only in the long term. The NEMS will provide the process which will assess these and other projects, and establish priorities. The following list of priority projects will provide some guidance and a reference point for this discussion.

## 15.2 Priority programmes

### **Natural environment**

- ◆ A Funafuti lagoon management plan incorporating a marine habitat monitoring programme, a limitation on fishing in some areas, and the reservation of marine protected areas to preserve the lagoon's biodiversity.
- ◆ A ban on further extraction of beach rock and sand, combined with the preparation of an extractive industries strategy to identify alternative sources of earth materials.
- ◆ A vegetation retention and replacement programme with an emphasis on foreshore areas.
- ◆ Identification of coasts vulnerable to erosion and incorporation of this information into land use planning and vegetation retention projects.
- ◆ Identification of the most fertile soils and adoption of land use controls which keep these areas available for agricultural production.

### **Human environment**

- ◆ Establishment of a comprehensive environmental education and information programme and its incorporation into Tuvalu's "Education for Life" policy.
- ◆ Establishment of a community based, conservation and environment non-government organisation.
- ◆ Preparation of a population management plan incorporating a family planning element, together with an assessment of the population capacity of each island and a decentralisation and inter-island migration policy.

### **Economic and built environment**

- ◆ Integration of economic and environmental planning policy.
- ◆ Review of the policy of relying on ground disposal for sanitation wastes and an investigation of alternatives (such as composting toilets).
- ◆ Establishment of a comprehensive solid and chemical waste management project.
- ◆ Preparation of comprehensive and environmentally sensitive land use and development plans for each island.
- ◆ Examination of the environmental impact of the incremental growth in the number of motor vehicles in Funafuti.

### **Managing the environment**

- ◆ Establishment of a comprehensive environmental monitoring programme with a commitment to regular reporting of key indicators.
- ◆ Adoption of a policy to require all major new projects to be subject to an EIA process and



the operations of current industrial-type activities to be subject to environmental audit.

- ◆ Strengthen the environmental input to government coordination and decision-making systems.

- ◆ Review taxation policies to ensure that they positively support environmental protection objectives.

# References and other source materials



As can be seen from the following reference list, a considerable volume of literature on a wide range of topics relating to the environment of Tuvalu has been written over the past ten years. While there are gaps in the knowledge base which require further research, the real difficulty facing planners, administrators and others is access to documents and information. Knowledge which is not accessible is knowledge lost, and unfortunately most of the following texts are not available from the library in Tuvalu or elsewhere in the country. Some may be found on the shelves of individual government officers, but many cannot be found in Tuvalu at all. Regional organisations or the authors may have copies.

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# Bird species of Tuvalu

Common name	Scientific name
White-tailed tropicbird	<i>Phaethon lepturus</i>
Red-tailed tropicbird	<i>Phaethon rubricauda</i>
Pacific reef-heron	<i>Egretta sacra</i>
Great crested tern	<i>Sterna bergii</i>
Black-naped tern	<i>Sterna sumatrana</i>
Sooty tern	<i>Sterna fuscata</i>
Spectacled (Gray-backed) tern	<i>Sterna lunata</i>
Common fairy tern	<i>Gygis alba</i>
Brown noddy	<i>Anous stolidus</i>
Black noddy	<i>Anous minutus</i>
Blue-gray noddy	<i>Procelsterna cerulea</i>
Pacific pigeon	<i>Ducula pacifica</i>
Lesser golden-plover	<i>Pluvialis dominica</i>
Wandering tattler	<i>Heteroscelus incanus</i>
Siberian (Gray-tailed) tattler	<i>Heteroscelus brevipes</i>
Bristle-thighed curlew	<i>Numenius tahitiensis</i>
Ruddy turnstone	<i>Arenaria interpres</i>
Sanderling	<i>Calidris alba</i>
Long-tailed cuckoo	<i>Eudynamis taitensis</i>
Christmas shearwater	<i>Puffinus nativitatis</i>
Audubon's shearwater	<i>Puffinus lherminieri</i>
Masked booby	<i>Sula dactylatra</i>
Brown booby	<i>Sula leucogaster</i>
Red-footed booby	<i>Sula sula</i>
Great frigatebird	<i>Fregata minor</i>
Lesser frigatebird	<i>Fregata ariel</i>
Whimbrel	<i>Numenius phaeopus</i>
Banded rail	<i>Rallus philippensis</i>

# Environmental management and protection laws of Tuvalu

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## **Land or resource use and management**

- ◆ *Closed Districts Act* — declaration of closed areas; commenced 8 December 1936.
- ◆ *Marine Zones (Declarations) Act* — regulation of marine waters including the Exclusive Economic Zone; commenced 1 January 1984.
- ◆ *Mineral Development Licencing Act* — regulation of mineral exploitation; commenced 1 January 1978.
- ◆ *Native Lands Act* — relates to native lands and registration of titles; commenced 14 March 1957.
- ◆ *Neglected Lands Act* — provides for the purchase of neglected land and its sale to others; commenced 25 June 1959.
- ◆ *Prohibited Areas Act* — declaration of certain islands and waters as prohibited areas; commenced 22 March 1957.

## **Coastal management and protection**

- ◆ *Foreshore and Land Reclamation Act* — declaration of ownership of foreshores, and regulates reclamation projects; commenced 10 June 1959.

## **Conservation of flora and fauna**

- ◆ *Fisheries Act* — regulates fishing and fishing industries and protection for specified fish species; commenced 1 July 1978.
- ◆ *Plants Act* — protection of endangered or culturally important plants; commenced 1 March 1977.
- ◆ *Wildlife Conservation Act* — protection of birds and animals and establishment of

conservation reserves; commenced 29 May 1975.

## **Water, sanitation and environmental health**

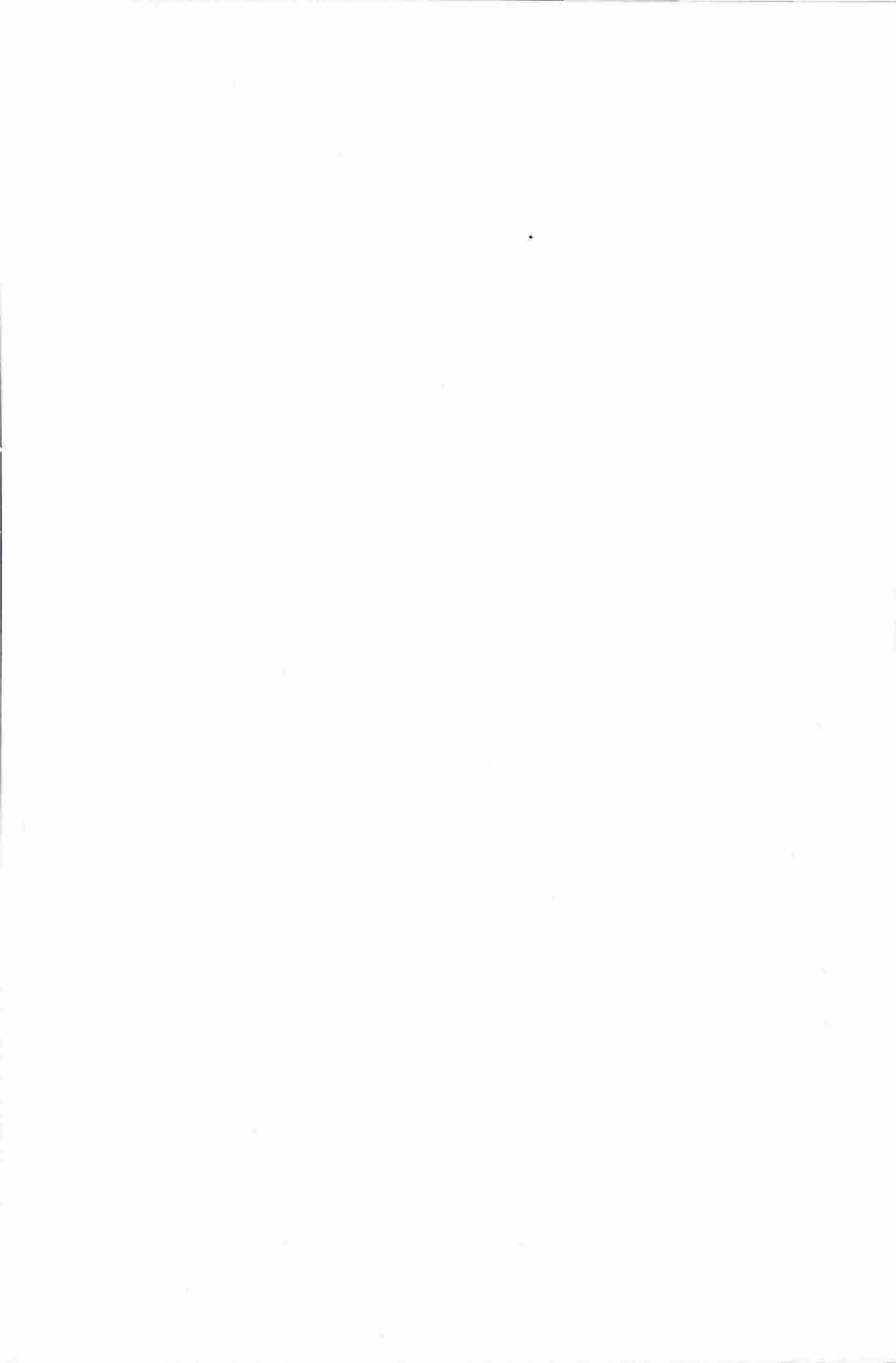
- ◆ *Importation of Animals Act* — regulates the importation of animals; Part III commenced 17 July 1919, Remainder 3 June 1964.
- ◆ *Public Health Act* — maintains adequate standards of health; commenced 1 December 1926.
- ◆ *Quarantine Act* — regulates the importation of products of potential danger to health or industry; commenced 1 January 1931.
- ◆ *Water Supply Act* — provides for the protection of water supplies; commenced 24 July 1967.

## **Control of environmentally disruptive substances and materials**

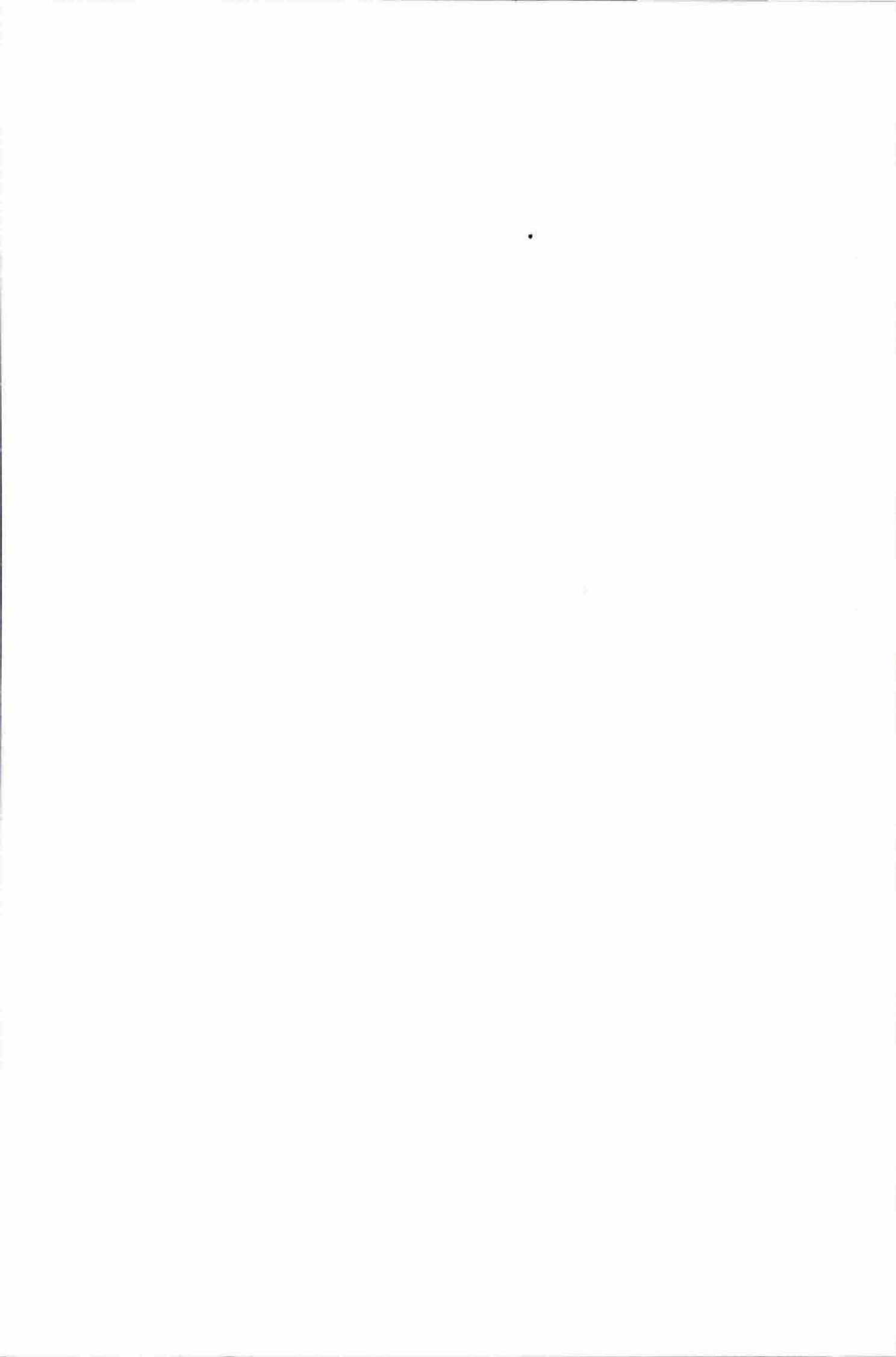
- ◆ *Merchant Shipping (Oil Pollution) Tuvalu Order 1975* (application of United Kingdom laws) — control of oil pollution incidents; commenced 3 January 1976.
- ◆ *Nuclear Installations Ordinance (Gilbert and Ellice Islands) Order 1972* (application of United Kingdom laws) — control of nuclear installations; commenced 15 March 1972.
- ◆ *Wrecks and Salvage Act* — provides for the rights of wrecks and salvage; commenced 7 February 1966.

Other legislation pertaining to environment management and protection include the *Pesticides Act* (commenced 1 January 1991); *Livestock Diseases Act*; and the *Marine Pollution Act*.











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