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State
Of the
Environment
Report

Kiribati

Kiribati

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E*nvironment Report*
1994

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Coordinating editor
Suzanne Grano

Editors
Roslyn Sharp and Barbara Henson

Design and production
Peter Evans

Artwork for symbols
Catherine Appleton and Karawa Areieta

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Cover photograph: 'Te kaina', Pandanus tectorius. *Its fruits are a staple food source and the fronds are used for handicrafts. (photo: Cait Wait)*

Kiribati

State Of the Environment Report 1994

By Craig Wilson
Environment Unit
Ministry of Environment and Natural Resources Development
Republic of Kiribati

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

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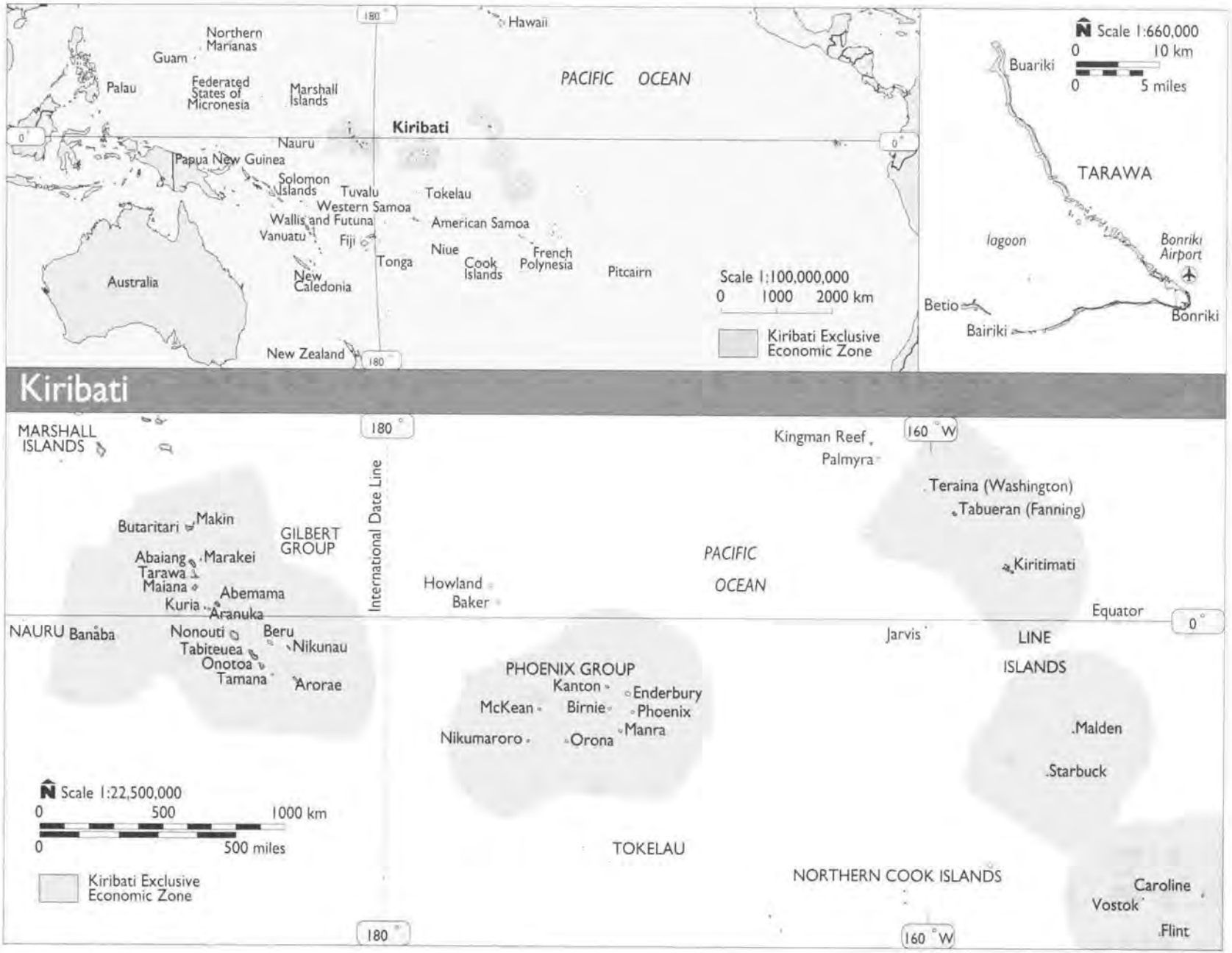
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Tabueran (Fanning)
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Foreword

This document represents a concise report on the state of the environment for Kiribati. It was prepared as a 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 was funded by the United Nations Development Programme (UNDP) and implemented through the South Pacific Regional Environment Programme (SPREP) as part of a broader assistance project 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.

The State of the Environment Report for Kiribati is a comprehensive reference document on the current status of Kiribati's environment which should act as a benchmark against which changes to the environment can be gauged. The report summarises the current state of knowledge about the environment of Kiribati in areas such as the terrestrial environment, marine resources, cultural and archaeological resources, socio-economic environment and outlines environmental challenges facing Kiribati. The State of the Environment Report also provides an important vehicle for raising awareness of the community to the importance of environmental issues and how these should be integrated into future decision-making processes.

I would like to thank Craig Wilson, Environmental Advisor to the Ministry of Environment and Natural Resources Development, Government of Kiribati for his work in preparing this State of the Environment Report. SPREP looks forward to working with Kiribati and with 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

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Note The currency unit in Kiribati is the Australian dollar ($A). All currency amounts in this document are in Australian dollars, unless otherwise specified.

Acronyms

ACIAR	Australian Centre for International Agricultural Research
AMAK	Aia Maea Ainen Kiribati
DWFN	Distant Water Fishing Nation
EDB	Equatorial Doldrum Belt
EEZ	Exclusive Economic Zone
ENSO	El Niño and the Southern Oscillation
ESCAP	Economic and Social Commission for Asia and the Pacific
EU	Environment Unit
FSP	Foundation for the Peoples of the South Pacific
GDP	Gross Domestic Product
IPCC	Intergovernmental Panel on Climate Change
ITCZ	Inter Tropical Convergence Zone
IUCN	World Conservation Union
KTFE	Kiribati Task Force on the Environment
MENRD	Ministry of Environment and Natural Resources Development
MHARD	Ministry of Home Affairs and Rural Development
NEMS	National Environmental Management Strategy
NGO	non-government organisation
NLI	Northern Line Islands
RERF	Revenue Equalisation Reserve Fund
SLI	Southern Line Islands
SOE	State of the Environment Report
SOI	Southern Oscillation Index
SOPAC	South Pacific Applied Geoscience Commission
SPACHEE	South Pacific Action Committee for Human Ecology and the Environment
SPBCP	South Pacific Biodiversity Conservation Programme
SPC	South Pacific Commission
SPCZ	South Pacific Convergence Zone
SPREP	South Pacific Regional Environment Programme
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme

UNEP	United Nations Environment Programme
WCU	Wildlife Conservation Unit
WHO	World Health Organization

Glossary

Kiribati words

maneaba	Village meeting hall.
te bun	Ark shell.
te bwabwai	Giant swamp taro.
unimane	Elder men.

General

algae	Non-flowering, stemless water-plant, especially seaweed and phytoplankton.
aquaculture	The farming of marine or freshwater plants and animals.
balance of payments	Earnings from exports compared with overall spending on imports.
bilateral and multilateral	Bilateral aid or trade agreements are made between two governments or organisations. Multilateral agreements are made between more than two countries or organisations.
biodiversity	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.
ciguatera	Fish poisoning.
conservation	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.
consumption	Spending on everyday items, for example, food, petrol, rent, clothing etc.
deforestation	Clearing of trees or forest.
degradation	The result of poor resource use which pollutes, damages or reduces the quality of resources available to future generations.
demography	Measures of change in size and age structure of a population.
disturbed	Change in the natural order as the result of human activities or climatic change.
ecology	Branch of biology which deals with the relation of plants and animals to their environment.
economic growth	The increase in the value of goods and services produced in a country, usually measured over a year.
ecosystem	A community of plants and animals and the environment they inhabit.

effluent	A liquid flow.
endangered species	Species that are in danger of extinction.
endemic	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.
environment	All the living and non-living things in a particular place or on the earth generally, and the way they interact or work together.
erosion	The wearing away of the earth's surface (for example, soil) by the action of water, wind etc.
fauna	Animals.
flora	Plants.
greenhouse effect	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.
gross domestic product	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.
groundwater	Water found in soil or in the pores and crevices in rock.
guano	Build up of bird droppings in places inhabited by large colonies of sea birds.
habitat	The natural home of a plant or animal species.
heritage	A nation's historic buildings, monuments, places etc., especially when regarded as worthy of preservation.
hydrological	Relating to water, whether surface water in rivers or groundwater available in wells.
indigenous	Something that originally occurred in a particular area.
infrastructure	The basic structural foundations of a society or enterprise. Also refers to basic facilities such as roads, airports, electricity and communication systems.
introduced species	A species which does not naturally occur in a particular area but rather has been brought in from outside.
investment	Spending on projects or activities which are expected to provide long-term benefit.
natural resource	A naturally occurring stock or supply which can be used to help meet human needs and wants.
neap tides	Tides which occur during the second and fourth quarters of the moon.
nutrient	A substance providing essential nourishment for the maintenance of life.
ozone layer	A layer of ozone in the stratosphere which absorbs most of the sun's ultraviolet radiation.
pelagic fish	Fish that live in the open ocean rather than close to shore.
permeable	Able to be penetrated, for example, by water.
pesticide	Chemical that kills unwanted organisms.
primary sector	Activities relating to agriculture, fishing, forests, mining etc.
private sector	Activities and enterprises run by individuals or groups on a profit-making basis.
public sector	Activities and enterprises run by government.
resource	A stock or supply which can be used to help meet human needs and wants.
sediment, sedimentation	Matter which settles to the bottom of a liquid.
species	A scientific name given to each different type of animal or plant.
strategy	A plan to help achieve certain goals.

subsistence	Producing mostly for own consumption, for example, farming which directly supports households without producing a significant surplus for trade or sale.
sustainable	Using a resource in such a way that its supply and quality are maintained indefinitely into the future.
terrestrial	Relating to the earth.
threatened species	Species which are likely to become endangered species.
toxic	Poisonous.
trolling	To fish by drawing bait along in the water.
understorey vegetation	A layer of vegetation beneath the main canopy of a forest.
vascular plant	A plant with conducting tissue.
vegetation community	A commonly occurring grouping of plants and trees.
wetland	Swamp or other damp area of land.

Executive summary

When the Environment Unit of the Ministry of Environment and Natural Resources Development was given the task of developing the National Environmental Management Strategy (NEMS), a key component in the process was to prepare the State of the Environment Report for Kiribati. The purpose of the report is to provide an up-to-date assessment of the state of the environment in Kiribati, measures that are being taken to ensure the health of the environment, the effect of social and economic factors on the environment, and predicted trends for the future.

Kiribati is a recently independent country made up of 33 coral islands and atolls located in the central Pacific where the equator meets the International Date Line. The country consists of three island chains with a total land mass of 820 sq km with an Exclusive Economic Zone area of 3.5 million sq km. The atolls developed from coral reef growth on extinct volcanic mounts following periodic rises and falls in sea level. Reef island formation, of which we now see the evidence, has been occurring for only the last 3,000 to 4,000 years.

As a result of the relatively young age of the reef islands, soil formation has been minimal and the resultant vegetation has developed on a nutrient deficient regime. The terrestrial vegetation has been subject to widespread disturbance due to human settlement and the introduction of coconut plantations. Only on uninhabited islands are remnant vegetation communities still present. Terrestrial mammal fauna is similarly limited with no endemic species present. Avifauna comprises extensive breeding sea bird colonies, migratory waders and one endemic land bird.

In comparison to the terrestrial environment, the marine environment displays substantially greater biodiversity. Extensive coral reef areas support a diverse array of faunal species while the open ocean is home for wide-ranging pelagic fish, in particular, tuna. Utilisation of marine resources provides Kiribati with its traditional subsistence food supply and its principal source of income. Utilisation of these resources in the future will require specialised management to ensure the resource is developed on a sustainable basis.

Historically, the settlement of Kiribati occurred around 2,500–3,500 years ago with migrations from South-East Asia and Samoa. Following nearly 80 years of British colonial rule, the former Gilbert Islands achieved independence in 1979, becoming the Republic of Kiribati. Traditionally, the social framework of Kiribati was developed on a village level with the old men as the decision makers. With independence, a democratic government based on South Tarawa was formed with representation from all the outer islands. The current population of approximately 72,000, with nearly one third living on South Tarawa, is rising at a rate of 2.2 per cent per annum. As traditional lifestyles make way for Western oriented practices, the traditional social framework is being eroded by the pressures of change.

The economic make-up of Kiribati is largely shaped by aid, with the licensing of foreign fishing vessels the only significant source of income which is internally generated. Government administration is the major source of employment. However, the development of a range of income-generating projects is expected to raise the level of production in the marine, service and agricultural sectors on South Tarawa and the outer islands.

The environment issues facing Kiribati occur on a number of levels. On South Tarawa the driving forces leading to environmental decline are population rise and urbanisation, combined with a lack of awareness of the effects of a changing lifestyle on the environment. The resultant effects are plainly

seen in a range of issues including unmanaged waste disposal, inefficient sewerage services leading to contaminated groundwater and lagoon water, the emergence of land-poor squatter areas, and the loss of terrestrial and coastal vegetation areas. On the outer islands where population levels are substantially lower, pressures on the environment are less evident.

The Government of Kiribati has recognised the need for sustainable development to ensure that conservation of the environment is maintained throughout the economic development process. Through the development and implementation of the NEMS, it is endeavouring to implement a range of measures to deal with the environment issues it faces. The wisdom of government decision making at this point in time will be reflected in the environment of the future.

Chapter 1

Introduction

1.1 Background and scope

Concern about the environment and understanding of its importance to human well-being have increased greatly in the South Pacific over the past decade. Recent initiatives have focused on ecologically sustainable development, effects of global climatic changes, and the maintenance of biological diversity. These initiatives reflect the reality that land use practices in Pacific countries are degrading the quality of their land, sea, fresh water and air.

Planning for the 1982 Conference on the Human Environment in the South Pacific (Rarotonga, Cook Islands) included the preparation of country reports which showed that many of the countries were concerned that their natural resources would no longer be able to satisfy the demands being placed on them. Seventy-five per cent of the countries were experiencing reef pollution, 60 per cent reported problems with solid waste disposal, and 90 per cent had problems disposing of liquid waste, particularly human effluent. More than half of the countries reported problems with toxic chemicals and most were concerned about the threat of oil spills. A wide range of coastal zone management problems were identified (see also Carew-Reid 1989).

As a result of initiatives by the South Pacific Commission (SPC), the United Nations Environment Programme (UNEP), the South Pacific Forum, and the Economic and Social Commission for Asia and the Pacific (ESCAP), the South Pacific Regional Environment Programme (SPREP) was established. This reflected the need for environmental coordination and cooperation on a regional basis and would ensure that the countries of the South Pacific actively participated in the management of their joint and respective environments.

1.2 National Environmental Management Strategy (NEMS)

In order to achieve integrated management of the environment, SPREP has initiated a programme to facilitate the preparation of National Environmental Management Strategies (NEMS) by each of its member countries.

In Kiribati the function of the NEMS will be to identify key issues of environmental concern and undertake institutional strengthening and training in environmental management through the implementation of selected programmes. These programmes will be target projects that have been identified as having particular importance for the protection of the natural environment and the implementation of sustainable development practices for Kiribati. The list of programmes presented in the NEMS has been derived from the same consultative process which developed the NEMS. They have been considered and endorsed by the Kiribati Task Force on the Environment (KTFE) and Cabinet.

The National Environmental Management Strategy is a long-term perspective of a range of strategies and programmes through which Kiribati may achieve its aim of sustainable development. Its focus is on the sustainable use of species or ecosystems which the country relies on for both its daily subsistence and its future development. Given the many constraints on finance, time, available information and logistics, the Kiribati NEMS can only reflect the situation at this time; however, it can be updated to reflect the changes that occur in the future. The number of programmes and actions

Rural coastal view of North Tarawa.
(photo: Cait Wait)

suggested for government consideration is indicative of the broad range of strategies that are available for addressing the goals of the Kiribati NEMS.

The development of the NEMS is seen as an initiative to integrate environmental planning with economic development, and to achieve sustainable development in member countries. SPREP's NEMS Project and its related RETA Project were developed with funding from the United Nations Development Programme (UNDP), the Asian Development Bank (ADB), the World Conservation Union (IUCN) and the Australian International Development Assistance Bureau (AIDAB).

1.3 State of the Environment Report

An initial component of the NEMS is the preparation of a State of the Environment Report (SOE) for Kiribati. The SOE is a compilation of available resource information that provides an up-to-date description of the environment of Kiribati. It provides a current assessment of the environment and a prediction of future trends, and provides some of the information that will be used to develop the NEMS programme profiles. It is also hoped that the document will be used as a tool by resource managers as it provides the basis of a resource inventory.

A resource inventory that is progressively updated can be used to monitor changes that occur within a specific area of the environment. Such monitoring of the environment can also be used to detect any new problems that may be arising in the use of natural resources and can provide a basis for decisions about resource use on a sustainable basis.

As well, Kiribati is a signatory to a number of international conventions covering the protection of the environment, and is currently assessing further initiatives. As a requirement of these conventions, Kiribati has international reporting obligations. The

SOE may be used to comply with these requirements to ensure that the country remains closely linked with the broad spectrum of international environmental initiatives.

1.4 Overview of Kiribati

1.4.1 Physical description

The Republic of Kiribati is a newly independent country made up of 33 coral islands and atolls located in the central Pacific. It consists of three main island groups that straddle the equator from longitude 170° east to longitude 150° west.

The main island group, the Gilbert Group, was formerly part of the British Gilbert and Ellice Islands colony and known locally as Tungaru. The Gilbert Group consists of 13 atolls and 4 low coral islands. Rainfall is variable from the wetter northern islands down to the drier southern islands which have experienced periods of restricted rainfall in the past. The generally favourable conditions have allowed continuous occupation of the Gilbert Group by the I-Kiribati for the past 3,000 years. Over 90 per cent of the population live in the Gilbert Group and one third of the total population live on Tarawa, the capital and commercial centre of the Republic of Kiribati. Banaba (Ocean Island) is a single island approximately 500 km west of the main island of Tarawa. It is the only raised limestone island in Kiribati and reaches an elevation of about 80 m above sea level. The island was mined for its phosphate rock for a period of approximately 70 years until its deposits were exhausted in 1979. Mining has left the island in a highly disturbed state with little remaining evidence of its former vegetation communities.

The second of the island groups is the Phoenix Group which lies approximately 2,000 km to the south-east of the Gilbert Group and consists of 3 atolls and 5 table reefs. Its low rainfall has precluded constant settlement although Abariringo (Kanton) Atoll was the site of a United States military base. The islands of the Phoenix Group are important sea bird and turtle nesting sites and wildlife protection areas have been established to protect the existing populations.

The remaining island group is the Line Islands comprising the Northern Line Islands (NLI) and Southern Line Islands (SLI). The group lies approximately 4,000 km to the east of the Gilbert Group. Rainfall varies from wet in the northern part of the NLI to dry in the SLI. Kiritimati is the most populated island of the group and with 363.7 sq km is the largest in terms of its land area. Kiritimati constitutes almost half of the Republic of Kiribati's total land area. The Line Islands support a distinctive array of flora and fauna and contain both sea bird and terrestrial bird nesting areas of international conservation significance. Areas within the Line Islands have been designated as managed areas under the *Wildlife Conservation Ordinance 1975*.

1.4.2 Increasing environmental pressures

On a worldwide basis the pressures on the natural environment range from increasing urbanisation or imbalance in population distribution to an increased capacity to exploit available resources owing to technological advances. Island systems in their natural state are extremely vulnerable to irreversible change from natural events such as cyclones, and from humanly induced competition for resource use. Worldwide, 93 per cent of all bird extinctions since 1600 have been island species, and the majority of endangered species are island endemic. Currently, there are more endangered species per head of population and per unit of land in the South Pacific than anywhere else in the world (Carew-Reid 1989). Thus, the effect of change from natural sources, in combination with a long period of human habitation, is having a profound impact on the natural environments of Pacific countries.

1.4.3 Emphasising environmental management

Kiribati typifies the effect of such changes, accelerated by demographic imbalances. The traditional cultures of the I-Kiribati people have incorporated a conservation ethic that in many cases was implemented under the guise of protection of knowledge, land tenure or through traditional practices and taboos. This ethic is currently being lost through a change in lifestyle from a traditional to a more Western one. However, it will need to be re-emphasised, particularly at the community level, if the Kiribati government intends to introduce regulated conservation techniques that will be acceptable to the wider community. Experience in environmental management has shown that the importance of community input cannot be overestimated when the management of natural

'Te katiru', Ixora casei, is commonly found in household gardens. (photo: Cait Wait)

resources is considered a requirement for survival. When the survival of natural and human populations is reliant upon healthy and robust ecosystems, cooperative conservation measures are essential.

In Kiribati, the emphasis on environmental management will need to be approached on two levels. In areas where there has been substantial environmental impact and degradation, a reactive or catch-up level of environmental management will be required to deal with the current degradation before forward management initiatives can be implemented. Currently, these areas are restricted to the higher population areas of South Tarawa in the Gilbert Group and, to a lesser extent, Kiritimati Island in the Northern Line Islands. In the Outer Islands (the term used in Kiribati for all islands apart from South Tarawa), a proactive or forward method of environmental management can be implemented to ensure that the use of resources occurs on an ecologically sustainable basis.

In the outer islands, resource degradation has occurred but is restricted to island-specific events such as the mining of Banaba, and the effects of causeway construction on coastal processes as evidenced on Kuria and Marakei in the Gilbert Group. Environmental management can be implemented as a process to reinforce the commitment that the Government of Kiribati has made to sustainable development (Republic of Kiribati 1993). Realisation of this commitment to sustainable development will be reflected in the approach that the government takes at the local, regional and global levels of environmental action.

At a local level, government will need to ensure that the community is made aware of the environmental and social costs of development, and to ensure that the community and all government departments actively participate in the decision-making process. At a regional level, government will be advantaged by active participation with organisations that can provide direction and advice on decisions affecting the environment. At a global level, the concerns of smaller developing nations can be most effectively expressed by participation in international fora, both as individual countries and in concert with regional organisations.

Chapter 2

Physical description

2.1 Location and geography

The Republic of Kiribati occupies an Exclusive Economic Zone area of 3.5 million sq km in the central Pacific between latitudes 5° north and 11° south, and between longitudes 170° east and 150° west. The 33 islands and reefs have a total land area of approximately 820 sq km which results in a sea to land ratio of 4000:1. This compares with Fiji with a ratio of 70:1, and Papua New Guinea with a ratio of 7:1. The land and ocean areas are distributed through the three island groups as in Table 2.1.

Table 2.1 Land and ocean areas (sq km)

Group	Land area	Sea area
Gilbert Group	278	1,098,300
Phoenix Group	29	758,600
Line Islands	516	1,649,500

Source: MENRD records

2.2 Climate

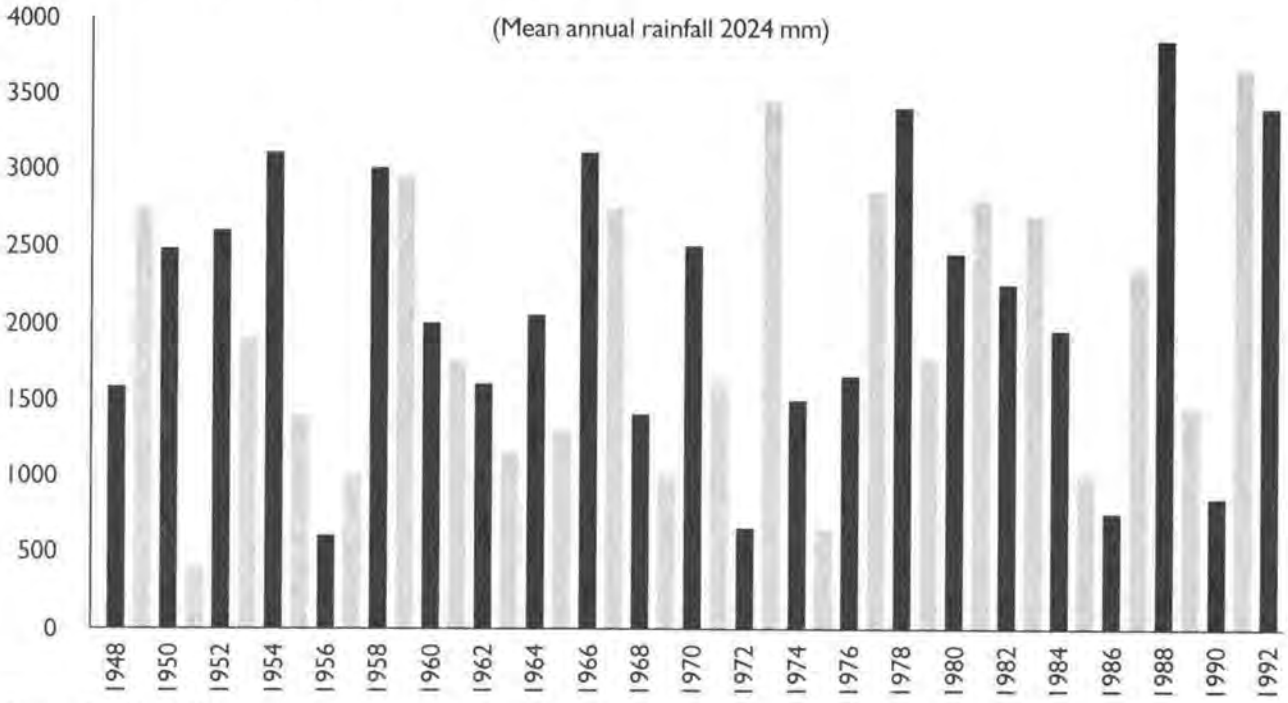
2.2.1 Rainfall

Most of Kiribati is located in the dry belt of the equatorial climate zone with mean daily temperatures ranging from 26 to 32°C. Rainfall is variable both annually and between the island groups. Rainfall in the Gilbert Group varies from 1,000 mm on the equatorial islands to 3,000 mm on the islands located up to latitude 4° north. Mean average rainfall for Betio determined from records spanning the period 1948–1992 was calculated at 4,000 mm (Frankland 1992) (Figure 2.1). Rainfall for the Phoenix Group is in the range of 1,000–3,000 mm.

Rainfall on the Line Islands varies from 700 mm at Kiritimati to 4,000 mm at Teraina to the north. Marked fluctuations can occur particularly on Kiritimati which received 240 mm in 1985 and 3,730 mm in 1987, a fifteen-fold difference (Woodroffe & McLean 1992). Severe prolonged droughts with as little as 200 mm of rainfall have occurred in the central and southern Gilbert Group, Banaba, the Phoenix Group and Kiritimati. Severe droughts have led to the death of food-providing trees including 'te bwabwai' (giant swamp taro), breadfruit and coconut trees, the loss of the latter resulting in

'Te kaina', Pandanus tectorius, *is found throughout the atolls and islands of Kiribati. (photo: Cait Wait)*

Figure 2.1 Annual rainfall, 1948–1992 (mm)



Source: Frankland 1992

a restriction of copra production. As copra is relied upon as a staple food and as a significant source of cash income, the effect of droughts on the community can be extreme. In the past, drought has also forced the relocation of communities from severely affected islands.

The climate is influenced by the seasonal movements of the Inter Tropical Convergence Zone (ITCZ), the Equatorial Doldrum Belt (EDB) and to some extent by the South Pacific Convergence Zone (SPCZ).

The EDB is a region of light easterly and westerly winds that are present throughout the year. The EDB lies within 5° north of the equator and is in general an area of high rainfall and seasonal variability. In the area between the convergence of the North and South Pacific trade winds lies the ITCZ which is an extensive area of cloud, producing associated showers due to the ascent of air. It normally lies to the north of Kiribati and consists of a broken cloud mass. The SPCZ is an area of convergence between the equatorial easterly winds and the high latitude south-easterly winds. This zone has a minimal effect on the climate of Kiribati.

2.2.2 Winds

Winds between the north-east and south-east quadrant occur throughout the year. During the drier months from June to November the winds are generally from the south-east. During the wetter months of the year from December to May, the winds are from the north and east. Strong winds, showers and squalls occur from the north-west to south-west. Tropical cyclones rarely form within 5° either side of the equator. However, gale force winds from the south-west and the north do sometimes occur when cyclonic systems develop in latitudes greater than 5° north and south.

2.2.3 Southern Oscillation Index (SOI)

The Southern Oscillation Index (SOI) correlates the effect of a variation in sea surface pressure on the climate of Kiribati. It was discovered that when the sea surface pressures were abnormally high in the Indonesian region, they were correspondingly low in the South Pacific and vice versa (Gilmour & Colman 1990). The index was developed to record the pattern of change of sea surface pressure and water temperature and is commonly referred to as El Niño or ENSO (El Niño and the Southern Oscillation). When the average SOI for a year is negative, the ITCZ moves closer to the equator and the cloudy EDB moves to the south. In Kiribati, surface winds are more frequent from the south-west through north-west to north-east, and there is heavier than normal rainfall. When the averaged

SOI is positive, dry easterly winds are more predominant than usual. The central Pacific region has just experienced an extended El Niño season resulting in elevated rainfall for Tarawa.

2.2.4 Tides

Tides throughout Kiribati are semi-diurnal, that is, there are two high and two low tides every 24 hours. During mean low water of the neap tides, the reef flat does not dry out; however, during the spring tides the reef flats, especially on the lagoon side, dry out, exposing large areas of sand. During spring low tides the exposure of the sand flats allows for extended collection of shellfish, particularly 'te bun' (ark shell).

2.2.5 Currents

Ocean currents flow in a predominantly westerly direction at between 1.5 and 2.0 knots (0.8–1.0 metres per second) under the influence of the south equatorial current. Easterly currents occur among the more northerly islands as a result of strong westerly winds or from a southerly shift in the equatorial counter-current. Close to any island the current directions are modified by adjacent land areas and by the location of tidal channels through the reef. Tidal currents enter the lagoons across the submerged (western) reefs and across the reef flats through inter-islet passages. Strong onshore currents on the ocean reef flat produce linear sand bars that are determined by the direction of wave flow. The strength and direction of the currents determine the size, shape and location of the sandbars that occur on the lagoon side of inter-islet passages (Patterson Britton 1992).

2.3 Hydrology

2.3.1 General

The fresh-water resources of Kiribati are extremely limited and are confined to a single fresh-water lake on Teraina in the Line Islands, small ephemeral wetlands, and the presence of subterranean groundwater lenses on islands with the necessary land area and supportive rainfall.

Rainfall permeates the porous soils and forms a fresh-water lens over the underlying sea water. This relationship is based on the differing relative densities of fresh and sea water, with the lighter fresh water floating on the more dense sea water. Factors that affect the size of the lens are island width, rate of recharge of fresh water (rainfall can vary in El Niño years), the amount and type of vegetation present on the catchment area and man-made modifications to the land surface. The fresh-water lens at Bonriki, Tarawa, which is used for the town drinking water supply, has been estimated at 29 m deep (Woodroffe & McLean 1992). On small islands with restricted land areas, there tends to be a brackish water interface between the water bodies which can be influenced by the tidal range. The quality of the fresh water can be affected by the intrusion of salt water, faecal bacteria, storm run-off, fertiliser, pesticides, industrial discharges and other contaminants.

It is during periods of drought that the availability of fresh water on many of the islands becomes a limiting factor to the existence of human and floral/faunal communities.

2.3.2 Groundwater resources

The sustainable yield of Tarawa's fresh-water lenses is limited due to the amount of rainwater that can be stored, the percentage of rainfall that becomes fresh-water recharge, and the amount of rainfall that occurs within a particular period. Estimates of the sustainable yield for Tarawa are: Bonriki water supply area 1,000 m^3/day; Buota water supply area 300 m^3/day (Shalev 1992). Teaoraereke water supply area has the potential to supply 100 m^3/day, but a breakdown in negotiations between the traditional owners and the government over land use has resulted in its removal from the water supply system. Fresh-water lenses exist at Betio, Bairiki and Bikenibeu, but these have been withdrawn from use due to faecal contamination from human and animal waste. Unless stringent land planning measures are implemented to define areas of human settlement, the encroachment of villages onto water reserves will continue to result in a contaminated water supply.

As the population rises in Tarawa, so will the demand for water. At present the water is regulated to ensure that the lenses are not over-pumped, resulting in an inflow of saline water. Current demand requirements are elevated due to on-line problems. It has been estimated that 50 per cent of the water pumped from the lenses does not generate income due to pipe leakage, illegal connections, faulty or unread water meters and difficulties in the Public

Utilities Board accounting system (Shalev 1992). Unless dealt with, these problems will continue to place added strain on the water supply system.

Based on limited data, estimates of sustainable yields from the freshwater lenses on North Tarawa show that 2,000 m^3/day could be extracted for water supply. These lenses could be used to supplement the existing water supply. However, considerable upgrading of the present system would be required to carry an increased water load.

Some increases in the South Tarawa supply could be implemented with diligent monitoring to avoid over-pumping. The upgrading of the rainwater tank supply, especially to buildings with large roof areas, could reduce the demand on the water supply system. Report recommendations have consistently emphasised the current under-utilisation of rainwater, with either no collection facilities or poorly maintained collection systems on both government and private buildings (Shalev 1992; Frankland 1992).

2.4 Geological development of coral atolls

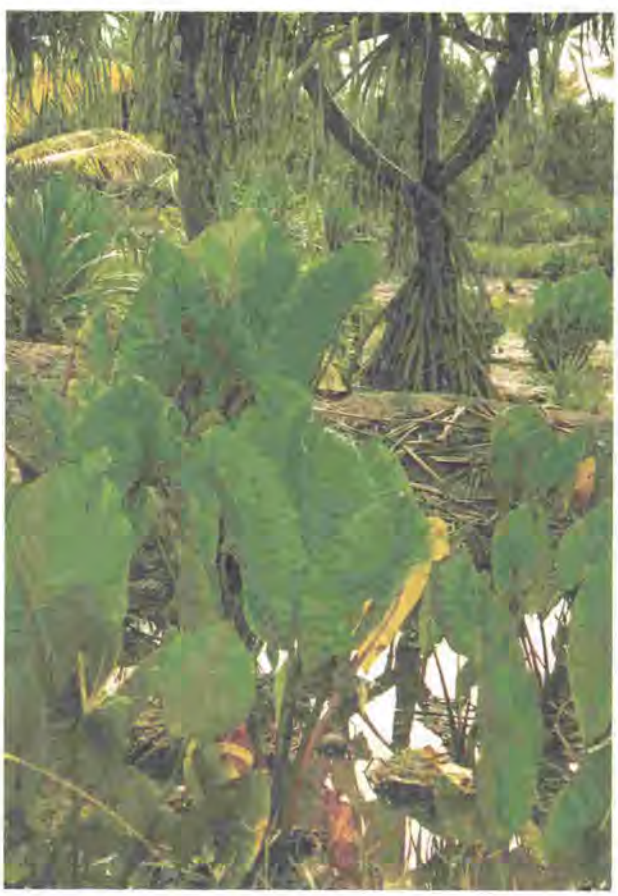
Coral atolls have developed on exposed areas of extinct volcanoes. As the volcanic islands subsided through tectonic transport, the reef areas grew vertically through the accumulation of coral. Reef growth was interrupted by fluctuations of sea level through the Ice Ages. During glaciations, sea level was at a reduced height and erosion of the established coral base took place. In the interglacial periods, sea level was restored and reef-forming processes continued. The upper 10–15 m of limestone has formed as the result of reef growth over the last few thousand years.

The evolution of all of the islands of Kiribati except Banaba would have followed a three-phase pattern of development. The first phase would have been rapid vertical reef growth from 8,000 to 6,000 years Before Present (BP) as the reef grew with the rapidly rising sea level. The second phase (6,000 to 3,500 BP) was a phase of reef-flat formation as reef growth caught up with sea-level rises and then consolidated. The third phase (from 3,500 BP to present) was one of reef island formation of which we now see the evidence (Woodroffe & McLean 1992). The islands of Kiribati are geologically very young (approximately 3,000–4,000 years old) and the processes of island erosion and accretion continue today as sediments are produced and transported by coastal processes.

2.5 Soils

The atoll soils of Kiribati are young (around 3,000–4,000 years old), shallow, alkaline, coarse-textured and, because of their immaturity, similar to the coral limestone parent material. They consist of shallow layers of organic material in varying thickness, coral sand and coral fragments overlaying a limestone platform. The soils are lacking in the trace elements iron (Fe), manganese (Mn), copper (Cu), and zinc (Zn) and exhibit high pH values (8.2–8.9) restricting availability of these elements for plant growth.

Plant growth is dependent on the recycling of nutrients from the shallow surface humic layer. The production of humic acids from the breakdown of organic material and the activity of soil organisms lowers the pH and allows for the uptake of nutrients.



'Te bwabwai', Cyrtosperma chamissonis. The giant swamp taro is cultivated extensively for its edible root. (photo: Cait Wait)

The soil has a low level of organic material due to its coarse texture and rapid rainfall infiltration, and does not lend itself to conventional agricultural methods, so an extensive composting technique was developed by 'te bwabwai' growers. The removal of understorey vegetation through clearing and burning reduces the ability of the plants to contribute to the soil-forming process and robs the soil of essential nutrients.

The plateau soils of Banaba vary from shallow soils, composed of organic material, sand or dolomite on the tops of limestone pinnacles, to deep phosphatic soils and phosphatic rock between the pinnacles. A substantial proportion of the soils have been extensively mined leaving isolated rock pinnacles. Undisturbed plateau soils have a high organic content and good fertility levels.

On a number of islands throughout Kiribati there are deposits of phosphate-rich soils which are old guano accumulations from extensive sea bird colonies, particularly those associated with stands of *Pisonia grandis*. These soils are more acidic and darker than the surrounding soils, and contain additional nutrients for plant growth.

Soils occurring in the wetland areas of Teraina and other low-lying areas within Kiribati are more acidic and fertile, as acidity associated with waterlogged soils makes the nutrients chemically available for plant growth.

2.6 Mineral resources

The mineral resources that can be found on Kiribati include:

- weathered and eroded materials formed from the coral limestone parent material;
- phosphate mined from Banaba Island;
- guano deposits; and
- seabed manganese nodules and cobalt enriched crusts.

The action of wind, water and wave-driven coastal processes on the coral limestone parent material has formed extensive deposits of sands and coral rubble of varying texture, particle size, location and quantity. This material is used for general building and construction work, the construction of causeways, and land reclamation projects implemented for both government and private purposes.

The Banaba phosphate mine stopped operations in 1979, having had 70 per cent of the identified deposit removed. A proposal to extract the remaining material was raised in the 1980s but did not proceed. Some interest has been shown in lagoonal phosphate deposits, and resource surveys have been under consideration by private mining concerns.

A number of islands in Kiribati contain deposits of guano developed from extensive sea bird populations. Deposits of calcium phosphate can occur when solutions leached from the overlaying avian guano and calcium carbonate form subsurface accumulations. The phosphatic material is a lightweight, pale to dark brown porous rock, which crumbles into round circular grains one or two millimetres in diameter, and is mixed with shell fragments, coral and coralline algae. Small deposits exist on some of the islands in the Gilbert Group, with the largest of these on Tamana being approximately 200,000 tonnes containing 15 to 20 per cent calcium phosphate (White & Warin 1964).

Deposits in the Phoenix Group and Line Islands were mined in the mid and late 1800s. Mining began on Jarvis in 1858 and lasted for approximately 20 years. Mining began on Starbuck in 1870, then extended to Flint, Malden and Caroline Islands. An estimated 200 million tonnes of phosphate was extracted from all these islands in the south equatorial Pacific (Keating 1992).

Deposits of cobalt-rich crusts in the Phoenix Group and polymetallic manganese nodules in the Line Islands have been identified. North-east of the Phoenix Group, manganese nodules were recovered during a sampling survey of the area, with the dominant nodule size being 2–4 cm in diameter. Deep-sea ferromanganese deposits have been considered a potential economic source of the metals nickel, copper, cobalt and manganese. For ferromanganese deposits to be considered as having potential economic interest, there must be a viable supply. The survey determined a patchy distribution of the nodules. However, where present, they occur in moderate to high concentrations. Further sampling was recommended (Bolton et al. 1992).

2.7 Energy resources

Kiribati relies heavily on imported fuels to meet a rising demand from the power generation and transport areas. Power for domestic, commercial and industrial purposes on South Tarawa is by

diesel generation, and the energy demand for power consumption is expected to rise by 6 per cent on South Tarawa over the next three years. The 1991 consumption estimate for petroleum-based fuels is 10 million litres, of which South Tarawa consumed 80 per cent with the remaining 20 per cent distributed to Kiritimati (10 per cent) and the outer islands (10 per cent). Given the country's isolation from producers and the cost of transport, the importation and consumption of petroleum-based fuels is placing a heavy burden on the balance of payments (Republic of Kiribati 1993).

The use of timber products (coconut residues and bushwood) as a fuel source on South Tarawa is resulting in a loss of suitable supplies, and on Betio fuel wood is having to be purchased to meet the growing demand. On the outer islands the household energy survey determined that 91 per cent of households use fuel woods as their primary energy source for cooking (Cleland 1985). The introduction of solar energy for the outer islands has occurred on a small scale, but is hampered by high initial capital and installation costs.

Chapter 3

Terrestrial environment

3.1 Vegetation

A range of terrestrial vegetation types can be found on the islands and atolls of Kiribati with considerable variation in condition according to levels of human habitation, the introduction of coconut plantations, and the effect of phosphate mining.

3.1.1 Mangroves

Mangroves are limited in area with approximately 53 km of mangroves colonising the shorelines of the Gilbert Group (Woodroffe & McLean 1992). The dominant species *Rhizophora mucronata* is the most widespread mangrove species in Kiribati. It forms an extensive stand along the western shores of atolls. More extensive stands occur on the northernmost atoll of Butaritari where *Sonneratia* sp. is found on the seaward shores. *Bruguiera* sp. and *Lumnitzera* sp. are also found in smaller areas in the Gilbert Group.

Mangroves are found in low-energy areas of lagoons and coastal inlets where fine sediments are able to accumulate. Mangrove root zones also provide food and shelter for a wide array of breeding fish. Specific qualities of mangrove timbers such as hardness and resistance to marine borers make them attractive for construction purposes and have contributed to the depletion of mangrove stands, particularly in highly populated areas. The expansion of the seaweed cultivation programme which uses local coastal timbers will need to be monitored to ensure the timber resource is developed on a sustainable basis. The impact of large-scale developments such as the extension of the airport into the Tarawa lagoon and the subsequent

*A recently colonised mangrove (*Rhizophora mucronata*) seedling. Mangrove root zones provide food and shelter for a wide array of breeding fish. (photo: Cait Wait)*

loss of mangroves has the potential to reduce lagoon fisheries and alter sedimentation rates, further affecting the coastal shoreline.

3.1.2 Coastal vegetation

Coastal vegetation is characterised by plants that are salt-tolerant. It includes tree species such as *Casuarina equisetifolia* ('te burukam'), *Pandanus tectorius* ('te kaina') and *Guettarda speciosa* ('te uri'), the understorey shrubs *Scaevola sericea* ('te mao') and ground covers *Ipomoea* sp. ('te ruku') and *Canavalia* sp.

3.1.3 Inland forest

Inland forest on the main islands of the Gilbert Group has been replaced by coconut *Cocos nucifera* plantations leaving only scattered stands and relic trees of the former community. The inland forest is characterised by *Pisonia grandis* ('te buka'), *Calophyllum inophyllum* ('te itai') and *Cordia subcordata* ('te kanawa') and the understorey shrubs *Scaevola sericea* ('te mao') with *Pandanus tectorius*.

3.1.4 Wetlands

Wetlands are found on Teraina and, to a lesser extent, as ephemeral wetlands on islands including Abaiang. The wetlands on Teraina have formed areas of peat bogs composed of the sedge *Scirpus riparius*.

3.1.5 Agricultural community

Agricultural community is dominated by the coconut *Cocos nucifera* ('te ni') and by swamp taro *Cyrtosperma chamissionis* ('te bwabwai'). These have been augmented by the introduction of pawpaw, bananas and breadfruit (*Artocarpus* sp.) and a range of vegetables including pumpkin and cucumber.

3.1.6 Amenity plantings

Amenity plantings around houses include the exotics hibiscus, frangipani and *Crinum asiaticum* which are used as garden plants and for land boundary delineations. The flowers of these species are incorporated into the traditional flower garlands used on ceremonial occasions.

In the drier Phoenix Group and Line Islands, where lower levels of human habitation have meant less impact on natural resources, the vegetation has maintained its intrinsic characteristics. Continued protection on these islands within established wildlife protection areas will ensure their preservation.

The vegetation community on Banaba has been virtually removed, and remnants of the once rich community now survive only as relics in isolated stands.

3.2 Flora

3.2.1 Description

The flora of the Phoenix Group and Line Islands comprises 283 species of which only 67 are indigenous. The flora of the Gilbert Group comprises 306 species of which only 83 are possibly indigenous. Of these indigenous species, 40 are severely restricted in their distribution, endangered, or possibly extinct due to removal and severe habitat modification (Thaman et al. 1992). The flora of Kiribati have been used for medicinal and ceremonial purposes, boat building and house construction using 68 different species of plant. A change in lifestyle away from traditional use has seen a loss of cultural floral knowledge as the younger generation turn towards Western goods and ideologies.

3.2.2 Current assessment

The most authoritative overview of the floral component of Kiribati is found in the country report for the United Nations Conference on Environment and Development (Thaman et al. 1992).

The floral status of Kiribati has been researched over a considerable time period (Christophersen 1927; Fosberg 1952, 1972; Fosberg & Sachet 1979, 1982; Luomala 1953; Manner, Thaman & Hussai 1984, 1985; Moul 1957 cited in Thaman et al. 1992 and others). Botanical or taxonomic research has tended simply to document plant species that were collected and identified without providing assessment or analysis of changes in vegetation patterns or structure. This can be due to remoteness of location and funding constraints which are disincentives to long-term ecological surveys.

In Kiribati the evident exposure of the vegetation to modification and disturbance was not extensively documented until the work of Thaman et al. in 1992. The relatively young age of the land masses of Kiribati (approximately 3,000 years old) would be expected to support a vegetation community

Lantana, an introduced plant. The natural vegetation of Kiribati has been subjected to widespread disturbance due to human settlement and the introduction of exotic plant species. (photo: Rupert Blaydon)

that was in a transitional succession stage. However, the successional progression, which is a natural change in vegetation types occurring over time, has been substantially altered by the introduction of a human presence — to the situation where on some, if not most of the islands, the natural vegetation structure is almost non-existent. As described in recent analyses, the introduction of the copra industry in the 1900s, magnified by the expanding population, has led to a decline in the natural community. Only on the unpopulated islands of the Phoenix Group and the Line Islands would one find a community exhibiting some semblance of originality.

However, Thaman et al. (1992) state that while the vegetation of Kiribati has been subject to the effect of extensive impacts over the 3,000 years of human habitation, and has been substantially modified during that period, it still provides the I-Kiribati people with an important socio-economic and cultural resource. Any current assessment would note that, especially on South Tarawa, the flora is being placed under ever increasing pressure as the population continues to rise.

3.2.3 Future trends

The future trends for the vegetation can be anticipated according to its exposure to population growth.

In areas of high population, particularly South Tarawa, the uncontrolled rise in population with uneven distribution, the introduction of exotic species and, on Betio, the effect of World War II, have resulted in a loss of vegetation and floral integrity. Until integrated land planning and environmental management plans are implemented and enforced, the clearing of vegetation to cater for additional housing and fuel-wood supply will continue until South Tarawa is left with only individual food trees. This scenario is not likely to occur on the outer islands, as population and competition for resources is not as intense there.

The *Plants Ordinance 1976* for protection of the vegetation, while existing in name, is not administered or supported to any noticeable degree. The declaration of wildlife protection areas on the Phoenix Group and Line Islands has been the most significant conservation method to date. The South Pacific Biodiversity Conservation Programme (SPBCP) administered by SPREP is in the early stages of implementation. However, it is expected to play a leading role in the defining and protection of unique and ecologically significant areas of Kiribati. The SPBCP will establish conservation areas under a cooperative management programme to ensure the protection and sustainable development of marine and terrestrial resources.

3.3 Fauna

3.3.1 Description

Terrestrial fauna throughout the Pacific islands is highly variable. Papua New Guinea has approximately 100 species of mammal, Solomon Islands has 52 species of mammal of which 50 per cent are endemic, while Kiribati has only the introduced Polynesian rat (*Rattus exulans*), feral cat, dog and pig.

The avian fauna of Kiribati comprises 75 species of bird with one endemic species, the Christmas Islands warbler *Acrocephalus aequinoctialis* ('te bokikokiko'), and on Tabueran the rare and endangered scarlet-breasted lorikeet *Vini kuhlii* ('te kura').

It is the extensive sea bird colonies of the Phoenix Group and Line Islands that contribute to the avian species of Kiribati. On the Northern Line Islands, 19 species of sea bird are known to breed and on Kiritimati have developed colonies numbering in excess of 6 million birds, the largest for any island in the world (AGRICO 1993). The main species include the wedge-tailed shearwater, sooty tern, great frigatebird and grey-backed tern.

The insect fauna has been studied on an agricultural basis in regard to species effect on plants and includes the breadfruit mealybug, the Papuana taro beetle which infests bananas, and the toddy beetle *Sessinia livida*.

The reptilian fauna is represented by a small number of species including the skinks *Emoia* sp., *Lipinia noctua*, *Cryptoblepharus boutonii* and the geckos *Lepidodactylus lugubris*, *Gehyra oceanica*, *G. mutilata* and *Hemidactylus* sp., all of which are widespread and well adapted to dispersal.

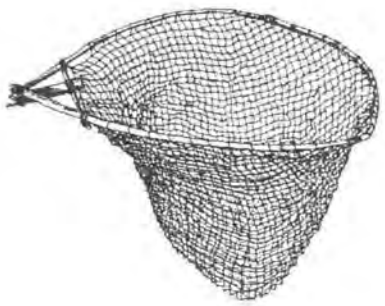
3.3.2 Current assessment

The mammalian fauna is a small component of the terrestrial fauna of Kiribati. Introduced fauna such as the feral cat, pig and dog have had a similar effect in Kiribati to that in other parts of the world: the introduction of parasites, predation of native animals and the destruction of native flora.

The avian fauna has been well documented in the Phoenix Group and Line Islands (Ashmole & Ashmole 1967; Bakus 1967; Clapp 1968 cited in Garnett 1983) and in the Gilbert Group (Morris & Bourne 1964 cited in Guinther et al. 1992). Its presence in large breeding numbers has been as a result of abundant available food supply, safe nesting sites and isolation from human and feral animal interference.

3.3.3 Future trends

The increase in population and in its mobility throughout the islands of Kiribati, together with a growing number of people arriving in Kiribati from overseas, has the potential to affect the existing fauna severely. The introduction of the ship rat *(Rattus rattus)* as transport links are established, and the growth of the feral cat population on the Line Islands along with further poaching by the local community have the potential to further reduce the natural resources of the islands. With a rise in the eco-tourism industry, any unregulated expansion has the potential to destroy the pristine characteristics that created the attraction. Only a coordinated management strategy and support from both government and the community can control the effects of change.



Chapter 4

Marine environment

4.1 Fauna

In comparison to the terrestrial fauna, the marine fauna of Kiribati exhibits greater biodiversity. Guinther et al. (1992) have estimated that 600 to 800 finfish species and approximately 200 species of coral could be found in Kiribati.

The existence of fish species is determined by habitat presence and condition. Specific habitat areas include the reef and reef slope, while within the lagoon coral patch reefs and seagrass beds are the principal habitat areas. While the biological condition of habitat areas is subject to the effects of natural events such as high-energy storms, human actions can have a significant effect on habitat condition. These effects include sedimentation that smothers coral reefs and seagrass beds, and the destruction of coral reefs by channel construction and the resultant change to lagoon hydrodynamics.

Research on the faunal resources has tended to concentrate on commercial species. However, extensive studies on the fauna of the Phoenix Group and Line Islands have been carried out (Chave 1974; Banner & Randall 1952; Clapp & Sibley 1971 cited in Guinther et al. 1992). Marine mammals from the Kiribati area include Fraser's dolphin, tropical spinner dolphin, blue whale, southern right whale and sperm whale.

4.2 Marine resources

4.2.1 Crustaceans

Of the crustaceans the rock lobster *Panulirus penicillatus* and *P. versicolor* are found on the surrounding reefs of the Gilbert Group but do not appear to be a significant food item (Prescott 1977).

Deep-water shrimp *Heterocarpus laevigatus* and *H. ensifer* which live at depths of 150–800 m have been considered for economic use, but no resource assessment has been carried out (Preston 1988). The coconut crab *Birgus latro* ('te aaii') is known from the Phoenix Group and Line Islands. The mantis shrimp *Lysiosquilla maculata* ('te waro') is sought after as a food item.

4.2.2 Giant clams

There are four species of giant clam found in the Gilbert Group: *Tridacna gigas* ('te kima'), *T. squamosa* ('te were matai'), *T. maxima* ('te were') and *Hippopus hippopus* ('te neitoro'). The first three species are found in the reef areas while *Hippopus* is usually found in rough, stony areas. *T. maxima* has been reported from the Phoenix Group and Line Islands. Giant clams have been utilised as a food source and for their shell as an incidental trade item. An unpublished survey by the Australian Centre for International Agricultural Research (ACIAR) found that clam species densities in Kiribati were much lower than those in Papua New Guinea (IMM 1993).

The ark shell *Anadara maculosa* ('te bun') is found in the intertidal region occurring naturally on Tarawa, Abaiang, Marakei, Maiana, Abemama, Tabiteuea and Nonouti. 'Te bun' is widely harvested and forms an important part of the diet. Other shellfish collected include *Gafrarium pectinatum* ('te koumara') and the ram's-horn shell *Spirula spirula* ('te katura').

The pearl oyster shell occurs in low densities on Abemama, Abaiang, Butaritari and Tabueran Islands. The Kiribati Fisheries Division and ACIAR are currently running a joint programme to develop the country's pearl oyster resources.

Sea cucumbers or bêche-de-mer have been

View of Abaiang. Edible shell fish and other marine resources found in the intertidal region in areas like Tarawa and Abaiang are widely harvested and form an important part of the diet. (photo: Craig Wilson)

collected from Kiribati mostly for export to other parts of the Pacific and to Asia. Of the 17 species in Kiribati, those collected commercially include the white teatfish *Holothuria fuscogilva*, black teatfish *H. nobilis*, prickly redfish *Thelenota ananas* and deep-water redfish *Actinopyga echinites*.

4.2.3 Pelagic fisheries

The pelagic fish resource is centred on the tuna fishery which is dominated by the species skipjack tuna *Katsuwonus pelamis*, yellowfin tuna *Thunnus albacares* and bigeye tuna *T. obesus*. Tuna catch rates by the Distant Water Fishing Nations have risen from 654,000 tonnes in 1989 to 957,00 tonnes in 1991 (IMM 1993). Tuna are fished either from pole-and-line boats or by large purse seine trawlers. Skipjack tuna are caught by local fishermen from small open boats and local canoes.

4.2.4 Inshore fisheries

Inshore fisheries include species from the near-shore, ocean reef and lagoon, and are fished by the traditional methods of poling and trolling with lures, gill netting, shallow and deep-water hand-lining, and scoop netting for flying fish at night. Fish species caught include snapper, mullet, milk-fish, bonefish, shark, goatfish, silver biddy ('nini-mai') and barracuda.

Construction of aquaculture fish ponds has occurred on a number of islands, concentrating on the production of milkfish both for local consumption and to supply the South Tarawa market.

4.2.5 Turtles

Turtles have been a source of food for traditional and non-traditional users. When the Pacific navigator Captain Cook journeyed to Kiritimati island in 1777, turtle meat became a staple food for the journey to Hawaii, and reports state they once caught 42 green sea turtles in half an hour (Onorio 1979). The hawksbill *Eretmochelys imbricata*, logger-head turtle *Caretta caretta*, Olive Ridley *Lepidochelys olivacea*, leatherback turtle *Dermochelys coriacea* and the green turtle *Chelonia mydas* are known from Kiribati and have been reported by a number of scientific expeditions including Fanning in 1798, Wilkes in 1814, Captain Trainer in 1813, Maude 1968 and Sabatier in 1977.

More recent observations of turtles have been from the Gilbert Group, and nesting sites have been recorded on many of the Phoenix Group and Line Islands (Balazs 1981; Teebaki 1986). Traditional users collect the eggs while the turtles are nesting, or catch them from the water either by gill netting, spearing or hooking them to a canoe (Onorio 1979). It is of concern that turtle stocks in the Pacific are declining because of the effects of pollution, exploitation for overseas markets and overfishing by local users. A regional turtle conservation programme has been established by SPREP to address the issue of declining stocks in the Pacific.

4.3 Flora

The marine flora comprises the seaweeds and seagrasses found in the tidal areas throughout the islands of Kiribati.

The seaweeds or marine algae are the non-flowering water plants which colonise habitats possessing a suitable regime of substrate, light and nutrients. Although the marine algae of Kiribati has been studied (Why & Reiti 1987; Tsuda 1964), it is the commercial species of seaweed grown in Kiribati that has attracted most attention. *Eucheuma cottonii (Kappaphycus alvarezii)* was introduced to Kiribati to be grown on a commercial basis in a number of selected lagoons following initial trials on Kiritimati and Tabueran (Casa Tec 1992).

Seagrass beds can be found on many of the islands of Kiribati. The two main species found are *Thalassia* sp. or turtle grass ('te keang') which is found on intertidal flats that have a 10–20 cm cover at low tide, and *Caulerpa* sp. which is found in the deeper water areas. The seagrass beds provide a food source, habitat and breeding area for a range of marine organisms, and serve an important function within the marine ecosystem.

Aquaculture ponds have been constructed on a number of islands for the growing of milkfish (*Chanos chanos*) for local consumption. Though the milkfish grown in Kiritimati are exported to Hawaii, the main use for milkfish is to provide an alternative fish supply to the outer islanders for the months when the sea is too rough for fishing. On Tarawa the aquaculture ponds are used to grow baitfish for use by the pole-and-line tuna boats operated by Te Mautari Ltd, the national fishing company.

4.4 Current assessment and future trends

4.4.1 Assessment

The fishing industry is of great importance to Kiribati, both economically and socially.

On a social basis a large proportion of I-Kiribati still live a traditional subsistence lifestyle, with marine resources providing the principal proportion of protein in the diet. Almost all rural households and 65 per cent of urban households fish for subsistence on a daily basis (IMM 1993). Estimates of fish consumption indicate that Kiribati has one of the highest levels in the world with an average consumption of 565 grams/capita/day (Thaman et al. 1992). Culturally, the relationship the I-Kiribati have established with the sea is reflected in their view of the sea as a provider of food and in its strong presence in the traditional stories passed down through families.

Table 4.1 shows the relative contribution of the fisheries sector to GDP.

Table 4.1 Sectoral distribution of GDP at factor cost (five sectors only)[1]

Sector	1985	1987	1988	1990 (est.)
Fisheries	14.5	11.5	14.6	11.9
Agriculture	13.2	8.7	16.7	7.2
Manufacturing	2.2	2.3	1.9	2.1
Construction	5.0	6.1	5.4	6.8
Government	26.0	29.3	25.3	29.9
	60.9	57.9	63.9	57.9

[1] Figures expressed as percentages. For complete table, see Table 6.2.

Source: Republic of Kiribati 1993

Revenue from fishing licenses contributed 37 per cent of total government recurrent revenue in 1991.

Fisheries surveys have been carried out on a number of the islands of the Gilbert Group (Mees 1984, 1985, 1986, 1987, 1988 cited in Gillett et al. 1991) and on the Line Islands (AGRICO 1993). The present catch rate on the outer islands is monitored through fish surveys and is currently assessed as a sustainable yield. Catch rates on South Tarawa are declining particularly for 'te bun' collected from the lagoon flats. Gillett et al. (1991) give a comprehensive list of fisheries-related information including resource assessments and surveys of specific species, and is a valuable tool for assessing resource sustainability as a part of future environment management policies.

4.4.2 Future trends

Future trends indicate that the offshore pelagic resources will be utilised by the Distant Water Fishing Nations (DWFNs) on a continuing basis, particularly the purse seine activity. It is expected that Kiribati will pursue the establishment of joint venture fishing operations with the intention of increasing its in-country capacity to utilise EEZ

resources. The recent commissioning of the Kiribati patrol boat will allow Kiribati to develop a more effective enforcement and surveillance capacity within the EEZ to ensure that the operations of DWFNs occur according to established agreements. Closer monitoring of DWFN fish catches by the Fisheries Division will ensure that reporting obligations are met.

The importance of the marine environment to Kiribati has been established, and its continued expansion is seen as a significant component of economic growth. Development of the fishery is expected to occur in two areas: (1) in the increased utilisation of the EEZ by Kiribati and DWFNs; and (2) as the population of Kiribati rises, a concomitant rise in resource use is expected. It should be emphasised that since marine resources are the major in-country source of funds for Kiribati, this will create extreme pressure on the resource as the fishing industry expands. It will be imperative for Kiribati to ensure that its marine resources, in particular the pelagic fishery, are developed on an ecologically sustainable basis to ensure their protection for future generations.

In Tarawa where the population density is greatest, the utilisation of the reef flats and lagoonal areas will increase, leading to greater pressure on existing stocks. The pressure on the marine resources in Tarawa Lagoon is already being seen in the dwindling supply of bonefish and giant clams. In the outer islands where the population pressures are less pronounced, a continued sustainable use is anticipated. The influence of expanding technology such as the use of outboard motors could be expected to increase catch rates, but this would not be considered to have a significant effect on current resources.

Small-scale fisheries on the outer islands will remain a substantial part of traditional lifestyles and will continue to generate supplementary cash income through the Outer Island Fish Project (funded by the United Kingdom and Japanese governments) that provides fish storage and transport facilities. Many of the islands have the capacity to increase utilisation of their fisheries. However, any increase should be matched with the sustainability of the resource. For many of the island fisheries, only limited knowledge exists concerning resource utilisation rates and a rapid rise in fisheries catch rates could deplete the available resources.

The prospect for a further expansion of the commercial seaweed operation appears promising with an injection of funds from the European Community. The expansion of the seaweed operation to the outer islands and the development of the Outer Island Fish Project will enable the local people to expand their cash income generation, the country will benefit from added exports, and the migration of people to South Tarawa may be slowed.

Chapter 5

Cultural environment

5.1 Introduction

Settlement of Kiribati has probably spanned around 2,500–3,500 years of human occupation. The Pacific islands were later resettled by ocean voyagers sailing their canoes from South-East Asia and other lands beginning around the 14th or 15th centuries. The voyagers brought their customs with them and then modified them to suit the new environment of high islands and low coral atolls which formed Micronesia, Polynesia and Melanesia. The process of settlement and adaptation continued until about 150 years ago resulting in the language and culture of the Pacific islands.

By the end of the 19th century most of the inhabited islands of the Pacific had come under the control of foreign powers which were represented by administrators, traders, missionaries and other agents of Western colonialism. Colonialism has had a marked impact on the social, cultural and natural aspects of the Pacific islands, and Kiribati is a prime example. The introduction of Christianity to Kiribati had a rapid and dramatic effect on the cultural life of the community. Many of the traditional cultural practices of the I-Kiribati were replaced by Christian-influenced ideas. Continuing cultural change is reflected in the lifestyles of the I-Kiribati people, especially those living in the commercial and administrative centres. It is also particularly evident in aspects of the natural environment.

In the former traditional order the I-Kiribati had a strong island connection. The people were conscious of their home island and considered themselves 'kain Abemama' (people of Abemama) or 'kain Butaritari' (people of Butaritari) according to their place. The colonial era lasted around 80 years. Independence in 1979 fostered a sense of national unity which is still developing today. Unity by both government and people is required for the task of governing and administering a string of islands spread over an extensive geographical area.

This challenge is also reflected in the difficulty of providing resources to the outer island areas and the difficulty in ensuring the protection of the natural environment. The task for the government will be to galvanise the strength and skills of the outer island people and to assist them in their task of managing their environment on a sustainable basis, and to foster in people on South Tarawa a sense first of being an I-Kiribati, and secondly a sense of home island identity.

The cultural heritage of Kiribati can be described in two areas:

(1) social historical preservation covering such aspects as common usage of language, retention of traditional song and dance, the continued production of traditional handicrafts, preservation of historic and archaeological sites; and

(2) natural resource conservation covering the protection of marine and terrestrial resources.

5.2 Social historical preservation

The social historical form of cultural heritage incorporates the traditional lifestyle practices and the physical aspects of the history of Kiribati.

In 1974 the Te Rikia N Tungaru Association was formed to ensure that aspects of I-Kiribati culture were maintained within mainstream life. The operation of the association was taken over by the Cultural Division in 1977, and attached to the Ministry of Education, Science and Technology. Within the same ministry is the Language Board whose function is to ensure, through the provision of a

'Te meria', Plumeria obtusa, is used in flower garlands for decorative and ceremonial purposes. (photo: Cait Wait)

translation service, that the Kiribati language is maintained against an ever rising English language influence.

Traditional dance and singing groups perform at formal events and traditional ceremonies, and the local schools hold song and dance cultural competitions. A number of community groups and non-government organisations (NGOs) have established handicraft stores where traditional items produced on the outer islands and Tarawa are sold for the local and tourist trade.

An archaeological expedition carried out in 1984 by the Tezukayama University on Makin identified a number of historical sites occupied by the early Kiribati settlers. Survey work has been carried out in Tuvalu to investigate that country's cultural links with Kiribati. On a more recent time scale a number of sites still remaining from World War II have been restored to provide a historical view of Kiribati's involvement in the war.

5.3 Natural resource conservation

During many years of habitation and use, a wealth of knowledge of the reef and fisheries resources was developed. Distribution, migration spawning cycles and feeding habits were observed and incorporated into the body of fishing knowledge.

Fish conservation methods varied and included:

- fishing regulations such as decrees that skipjack fishermen could not leave home before dawn and must return by midnight;
- that those collecting flying fish would fish in groups and that there would be no fishing within a fixed distance of traps and fish fences;
- sea, lagoon and reef ownership or tenure of adjacent waters;
- age, sex and clan taboos on various marine species; and
- the presence of ciguatera controlled the overfishing of species known to be susceptible.

Prior to colonisation the clans lived and fished their own adjacent waters. Following colonisation, clans moved to settlements and sea tenure gradually disappeared. The tradition of the knowledge of the sea is faced with competition from the introduction of more efficient fishing technology. As a result, traditional practices have declined, particularly on the more populated islands. On South Tarawa, the effect of cultural patterns such as having large families is leading to a population rise that, in combination with a change to more efficient Western fishing methods, is placing the natural resources under ever increasing pressure.

The development of sustainable lifestyles will

require a change of emphasis on South Tarawa as the influence of the cash economy grows. The change in emphasis to ensure the protection of the natural resources would benefit from the reintroduction back into modern usage of some of the traditional (or modified) conservation practices. This will require extensive consultation between government authorities and community groups, particularly the island councils and the fishermen, to ensure that the resources are utilised in a managed way.

5.4 Government

With independence in 1979 came democracy and the right of rule through the democratic process. Although the Westminster model was adopted, modifications were made to suit locally defined needs. The Constitutional Convention of 1977 opted for a President (to be elected by the people on a national basis) as an executive head of government rather than a Governor-General. This was to ensure that the strong egalitarian nature of society in Kiribati was maintained.

The government of Kiribati operates on a two-tier basis. The central government located in South Tarawa is complemented by local government councils from each of the islands. Members of the Kiribati House of Parliament or Maneaba ni Maungatabu are elected by the people according to population levels in the electoral districts. Laws for the nation are passed, and the duties and functions of the local island councils are defined. To select a President, the newly elected parliament elects a speaker who receives a minimum of four nominations for the Presidency. A nation-wide ballot is held and the President is then elected. The President then names Cabinet ministers from members of the House of Parliament.

Chapter 6

Social and economic environment

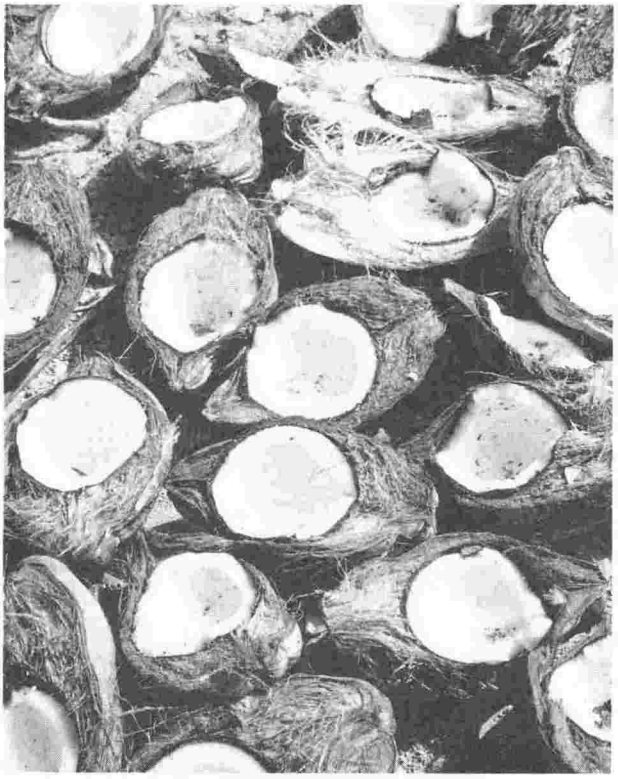
6.1 Social framework

The social framework of Kiribati that has developed over thousands of years of settlement is a subsistence lifestyle based on a strongly linked extended family or clan. The subsistence lifestyle, which emphasises life in the present, has created a culture that is reliant on the use of natural resources for its survival. Housing materials, food and means of transport were all derived from locally available materials.

The community social and political life was based on the 'maneaba' (village meeting hall). Decisions were made on the functioning of the community in the 'maneaba' on a consensus basis. The determination of a topic would be made by selected speakers from family groups, and when the topic was chosen a debate by all those present would occur. A majority decision would be made and conferred by the 'unimane' (elder men). The social structure of a community is greatly influenced by the composition of the 'maneaba' resulting in decision making that varies from one island community to the next. Prior to colonisation the islands ruled themselves as individual entities. However, since colonisation island councils have been established on each island with links to central government in Tarawa. The 'unimane' have representation on the council.

Christianity was introduced to Kiribati first by Protestant Christians in 1857 and then by Roman Catholic Christians in 1888 (Kirata 1985). Despite the initial reluctance of the I-Kiribati to embrace Christianity, the missionaries persevered and the majority of the population was converted.

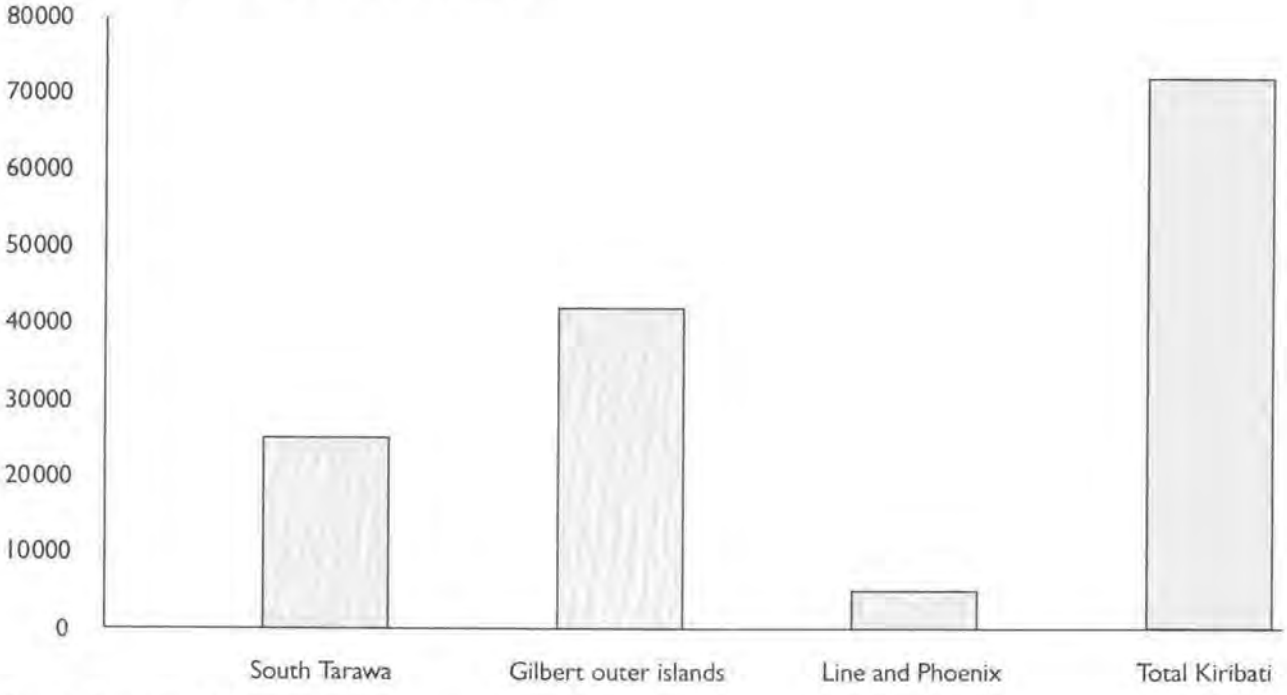
The social structures that have developed in Kiribati can be related to the type and rate of resource utilisation that occurs, and resource utilisation varies considerably between the outer islands and South Tarawa. On the outer islands, control of the resources is still a community matter and many decisions are made by traditional practices. On South Tarawa this is not necessarily the case, since the demand for food for such a large population has overridden many of the traditional controls, and many of the resource-use practices are unregulated.



Drying coconuts. (photo: Craig Wilson)

The population growth rate that South Tarawa is currently experiencing is influenced by the traditional concept that a large family is beneficial to overcome the high infant mortality and to ensure that the parents have family to look after them in

Figure 6.1 Population distribution, 1990



Source: Republic of Kiribati 1990

their old age. With better health care, lower infant mortality and rising life expectancies contributing to rapid population growth, the issue of family planning will need to be addressed by government and community groups such as the church. On South Tarawa, resource use to supply the rapidly rising population is increasing, and indications are that the pace of resource utilisation may exceed the capacity of the lagoon to supply a predicted population of 40,000 people by the year 2010 (Cole 1992).

6.2 Demography

The population of Kiribati at the latest census (1990) was estimated at 72,298 which showed a rise of 2.2 per cent from the previous census in 1985. Of this total, 35 per cent are found on South Tarawa, with 58 per cent on the Gilbert Group outer islands and the remaining 7 per cent in the Phoenix Group and Line Islands.

The population density in the Gilbert Group, where 93 per cent of the population of Kiribati live, varies with location. On South Tarawa (land area 16.5 sq km) where 25,000 people or 35 per cent of the total population live, the density is approximately 1,500 people/sq km. South Tarawa's share of the total population is projected to increase by 70 per cent to 40,000 which will comprise 39 per cent of the total population by 2010 (Cole 1992). The islet of Betio on South Tarawa (land area 2.0 sq km) has a population of approximately 9,000 people giving a density of about 4,500 people/sq km. By the end of the 20th century, Betio's population density is expected to rival that of Hong Kong.

It is the concentration of the population in such small areas that is contributing to the pressure for land and available resources and leading to environmental problems. Much of the population increase has been due to migration from the outer islands as families move to Tarawa for children's education and for employment prospects. Once established in South Tarawa, however, the trend is to remain rather than to return to the outer island. The migration is expected to increase further in the near future when the phosphate mining on Nauru is terminated and the I-Kiribati workers return home.

6.3 The economy

6.3.1 General

Kiribati is a small island nation constrained by its lack of available land area, geographic spread, isolation from world markets, and a limited capacity to utilise

its natural resource base. The majority of the population are employed in a subsistence lifestyle with formal employment dominated by the public sector (approximately 30 per cent of the active workforce).

Before 1979 the main source of income for Kiribati was from phosphate mining on Banaba. Mining ceased just prior to independence, resulting in a decline in the GDP by 45 per cent, a decline in government revenue by 55 per cent, and in export earnings by 80 per cent. By the end of the 1980s, GDP per capita was less than half the level experienced prior to independence. Following a decline in real GDP of more than 4 per cent in 1990, the economy began to recover in 1991 (Table 6.1).

Table 6.1 Growth of GDP, 1981–1992 (in percentages)

	1981–88	1989	1990	1991	1992 (est.)
Real GDP	1.3	-3.0	-4.5	2.4	1.5
Nominal GDP	7.1	2.1	0.1	8.0	6.6

Source: World Bank 1993

Revenue realised from the mining operation and lodged in the Revenue Equalisation Reserve Fund (RERF) provides funds for the country's future development needs. Over the past ten years, the value of the fund has risen from approximately $70 million in 1979 to $260 million at the end of 1991 (Republic of Kiribati 1993).

In 1990 Kiribati had an estimated Gross Domestic Product (GDP) per capita of $US 481 (World Bank 1993). GDP increased from $23.4 million in 1980 to $38.0 million by 1988 with most of the growth being generated from copra and fish exports. In 1990, the government was the major source of economic activity, contributing approximately 30 per cent to GDP, with fisheries at 12 per cent, agriculture 7 per cent and private sector manufacturing 2 per cent (Table 6.2). Recurrent expenditure increased from $14.4 million in 1980 to $16.3 million in 1988. Revenue for the same period, excluding transfers from the RERF, rose from $8.8 million to $13.4 million (Republic of Kiribati 1993). (Note that unless stated otherwise, all currency amounts are in $A).

6.3.2 Foreign debt

Policy decisions to limit foreign borrowings have resulted in low external debt and a debt service of less than 1 per cent of exports of goods and services. Substantial external assets are held in the RERF and in gross official foreign exchange reserves totalling approximately $260 million in 1991 (World Bank 1993).

6.3.3 Overseas aid

Development assistance, provided mainly by bilateral and multilateral aid donors, has increased in recent years. In 1991, it reached approximately $US 18.0 million in 1991 with four donors currently providing around 80 per cent of aid assistance (World Bank 1993). Development assistance has been focused on infrastructure projects in the transport and communications sector (approximately 35 per cent). The production sector (including fisheries and seaweed) and support for the Development Bank of Kiribati account for about 15 per cent of aid. Other sectors which have received assistance include health, finance, community development and education (IMM 1993).

Table 6.2 Sectoral distribution of GDP at factor cost (all sectors)[1]

Sector	1985	1987	1988	1990 (est.)
Agriculture	13.2	8.7	16.7	7.2
Fisheries	14.5	11.5	14.6	11.9
Manufacturing	2.2	2.3	1.9	2.1
Electricity & water	2.5	2.3	1.9	2.1
Construction	5.0	6.1	5.4	6.8
Wholesale, retail, hotels	13.8	15.3	13.6	17.0
Transport & communication	16.6	17.7	15.1	16.9
Finance & insurance	4.6	6.1	4.9	5.6
Govt. administration	26.0	29.3	25.3	29.9
Others	1.6	0.6	0.6	0.6

[1] Figures expressed as percentages.

Source: Republic of Kiribati 1993

6.3.4 Balance of trade

Kiribati's balance of trade suffers from the distance to international markets, a small domestic market and a low level of commercial investment hampering exports while imports are steadily increasing. Imports in 1991 totalled $33.2 million, widening the trade deficit from $15.7 million in 1980 to $29.0 million in 1991.

Private enterprise is low (2 per cent of GDP) in response to limited capital and limited financial and commercial management expertise. The potential for small labour-intensive industries is to be encouraged and is expected to be an area of future expansion.

6.3.5 Production activity

The two major exports from Kiribati are fish and copra which were valued at $4.2 million in 1991. Production and income from these areas have fluctuated in recent years due to the influence of variable weather and lower world market prices.

Fishing and marine resources

The fishing and marine resources sector contributed 11.5 per cent to the 1991 GDP which was a fall from previous years. Its share in exports has declined from 1989 to 1991 as catch rates have fallen. This fall can also be attributed to the decreased fishing operations of Te Mautari Ltd. Te Mautari experienced problems such as the use of unsuitable vessels and lack of baitfish leading to a reduced fish catch and subsequent financial problems.

A major source of foreign exchange earnings is the licensing of DWFN fishing vessels. By 1991 fees had risen by 52 per cent to almost $13 million (Table 6.3).

Table 6.3 Fishing licence fee income, 1985–1992

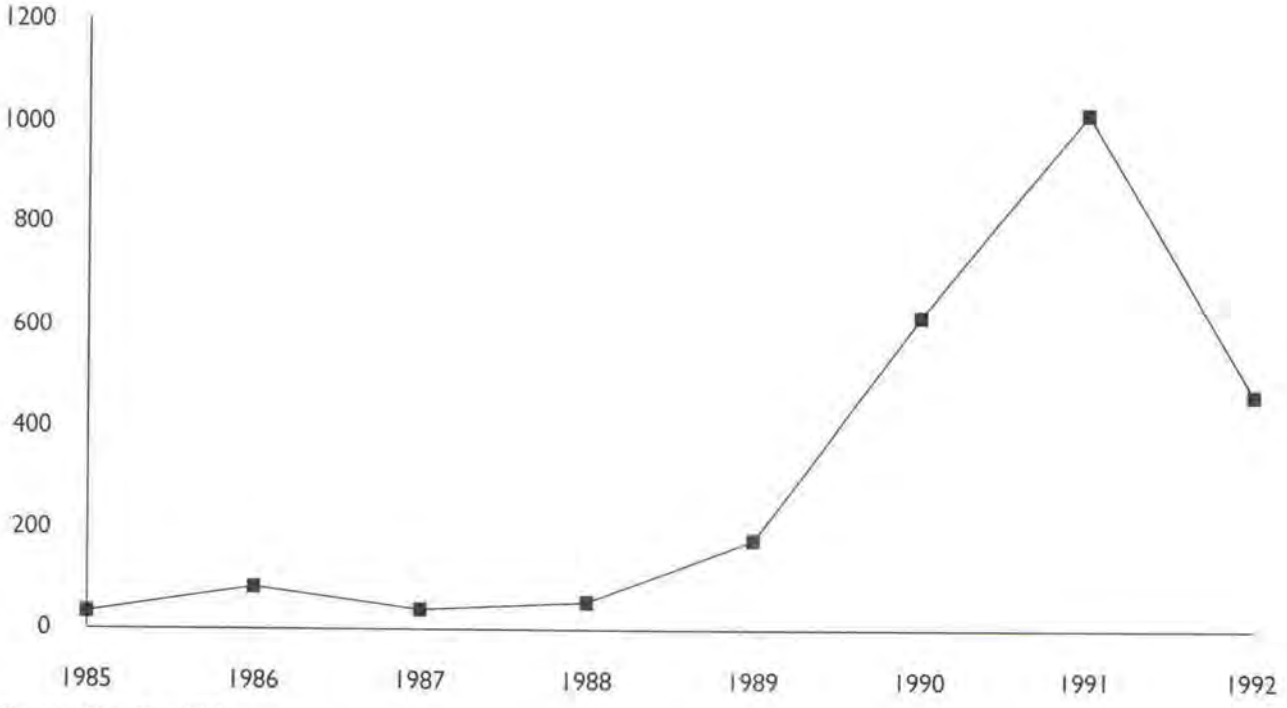
Year	Income $m
1985	3.15
1986	3.78
1987	2.07
1988	1.81
1989	3.23
1990	7.34
1991	9.27
1992	12.92

Source: IMM 1993

Seaweed

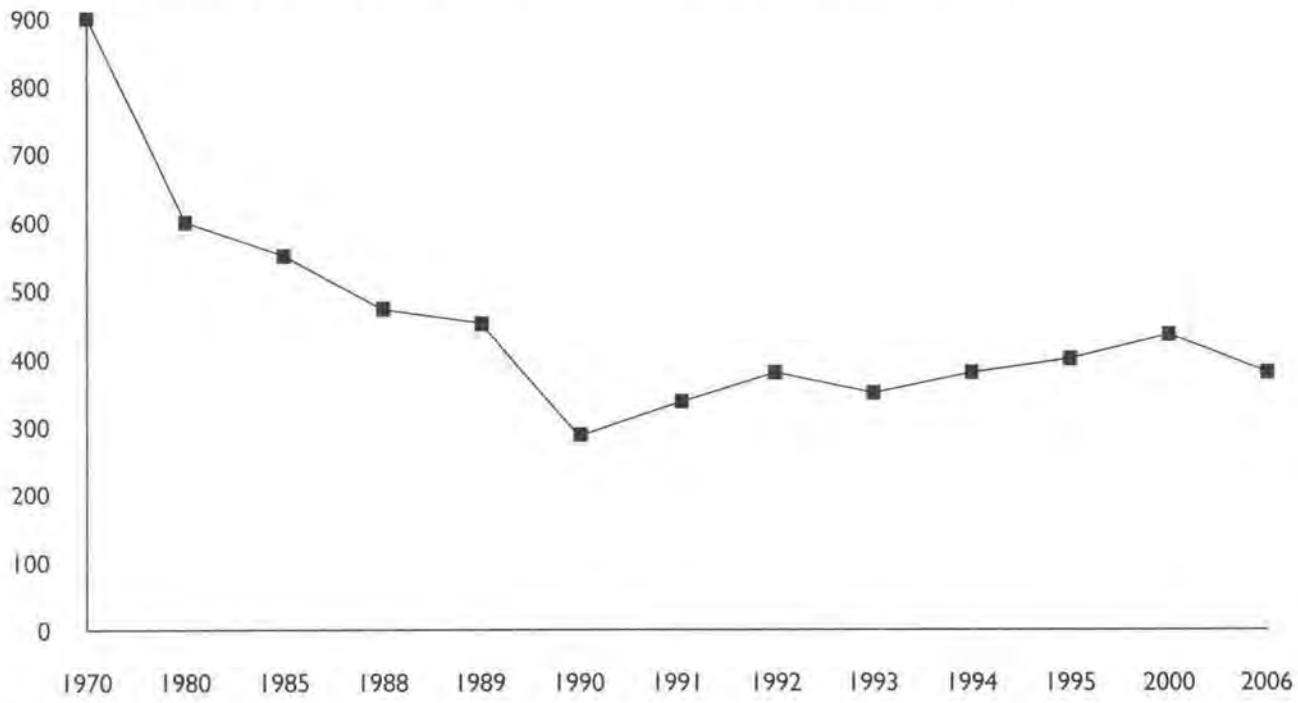
Seaweed production has shown a general increase since 1988 (Figure 6.2), and anticipated expansion in 1993 (despite seasonal fluctuations in 1992) is expected to make a greater contribution to export earnings. Seaweed production has risen in value from operations carried out on the outer islands and is expected to exceed the value of copra production, depending on weather and market fluctuations.

Figure 6.2 Seaweed production in the Gilbert Group (tonnes)



Source: Casa Tec 1992

Figure 6.3 Market price of copra ($US per tonne based on 1990 prices)



Source: *Pacific Islands Monthly* 1993

Agriculture sector

Copra production, which is a primary source of cash income for the population, has declined due to a fall in world prices from $500 per tonne in 1987 to $283 per tonne in 1990 (Republic of Kiribati 1993). World Bank predictions for copra show a continuation of the current prices with a slight decrease expected in 2005. The fall in price level has been compounded by a reduced production rate due to unsuitable weather and an ageing tree stock.

6.4 The development model

Development model theory has evolved as a method to describe the type of economic processes occurring within a country and to plan for future economic growth and development. The applicability of models is dependent upon the specific characteristics of the economy. It is therefore essential that the chosen model be valid for the type of conditions that exist.

One of the major disadvantages of past and, to some extent, existing models is that the detailed characteristics that determine the appropriateness of model theory are often not assessed, and assumptions based on generalities can lead to ineffective or inefficient development.

As outlined by McKay (1990), aspects of development theory that have been applied in numerous situations are based on a series of assumptions:

- development and growth are identical;
- growth can be achieved by the application of Western based science and technology; and
- as growth takes place, the social and political institutions of traditional society are replaced by modern forms.

These aspects of development have been adopted by many economies, and in specific Asian countries such as Singapore and South Korea economic growth has occurred at a great pace. As other developing countries adopt similar strategies to promote 'growth at any cost', the inappropriateness of certain aspects of the theory of modernisation becomes readily apparent.

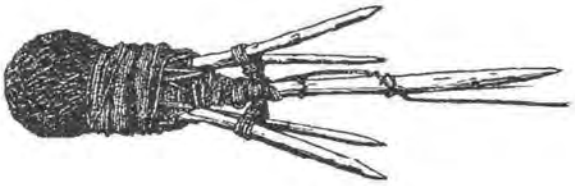
Rapid economic growth has seen an associated rapid decline in environmental quality. The assumption that before a country can afford environmental protection it has to create wealth, often on a short-term basis, is now being seen as a damaging

and often irreversible mistake as ecosystems collapse and natural resources are exploited beyond their capacity for rehabilitation.

In Kiribati, the promotion of economic growth as a model of development is pursued by all sectors of government as a way to increase the material well-being of the country and place it in line with other developing Pacific Island nations. Generally this economic growth model does not take into account the effects of economic development on the natural environment or on the social and cultural aspects of society. As can be seen in developed countries, the unrestrained pursuit of economic growth has led to widespread environmental destruction and the decimation of local indigenous cultures. These effects are being recorded in Kiribati, especially on South Tarawa where the influence of development is more apparent.

If Kiribati is to control the decline in environmental, cultural and social conditions, the development model of environmental sustainability will need to be implemented on a coordinated basis and backed by the necessary Environmental Impact Assessment and related environmental protection legislation.

Chapter 7



Specific environmental issues

7.1 Water quality

Following an outbreak of cholera in 1977, the water quality of Tarawa Lagoon was studied by Johannes et al. (1979) who determined that the groundwater, near-shore lagoon water and edible shellfish from the lagoon shores were contaminated by bacteria. Following the introduction of the saltwater sewerage system in 1983, a follow-up water monitoring study was carried out by Naidu et al. (1991) to assess any changes in water quality. The study found that:

- water quality along the lagoon flats of South Tarawa had not improved and in locations adjacent to villages, faecal coliform levels had risen;
- contamination levels in the shellfish 'te bun' had risen above standard levels for safe food consumption; and
- sampling of selected wells and 'te bwabwai' pits found that high levels of bacterial contamination were due mostly to animal wastes entering the unprotected wells.

A study carried out for the World Health Organization (WHO) by Wallis (1990) confirmed the presence of faecal contamination and presented a list of recommendations. The contributing factors leading to the contamination of water are the use of the lagoon for defecation and the presence of unprotected wells.

While the introduction of the sewerage system has not eliminated bacterial contamination from the lagoon, the study did note that contamination levels would have been higher had the sewerage system not been constructed. The system has suffered through negligible maintenance (the majority of the public conveniences are broken) and

This former 'te buia i taari' is now used as a rest area to enjoy the cooler sea breeze. (photo: Donna Dawber)

inadequate funding of repairs (many of the pumps are out of service at any one time) as leakages from the system go undetected.

The most recent water quality study carried out by Kelly (1993) found that bacterial contamination of the lagoon has worsened since those earlier studies. Of the 18 groundwater wells tested for faecal coliform, all exceeded the WHO standard for potable water. Gangaiya (1994) tested well water for nitrate content and found it unsuitable for human consumption according to WHO guidelines for drinking water quality.

The quality of the water and therefore the level of contamination is related to the level of population and the provision of suitable services. As the population rises and continues to place pressure on the sewerage system, the level of contamination and the potential for outbreak of disease is maintained.

In the outer islands, water quality monitoring has not been established on a regular basis. However, with the current density of the population, there is not expected to be concern, as long as siting recommendations are followed and a safe distance from toilets to wells is established.

Unmanaged waste disposal at Te Makin adjacent to fishing grounds presents contamination risk to groundwater and marine resources. (photo: Craig Wilson)

7.2 Solid waste disposal

Disposal of solid waste is a serious and increasing concern in Kiribati. A change in lifestyle from traditional subsistence to a Western oriented lifestyle, especially on South Tarawa, has dramatically increased the amount of imported goods and the volume of waste material requiring disposal. This change in lifestyle is in many ways a response to the changing situation, as the capacity to carry out traditional practices is constrained by a lack of traditional resources and an increase in competition for the limited available resources.

Traditionally, when all goods were biodegradable, disposal did not present a problem. Today, the influx of imported goods and associated packaging, waste material from industry, commercial and government activities, and the dumping of vehicles, construction equipment and machinery have created a waste disposal problem that shows no sign of decreasing. The problem is magnified by the lack of available land and the close proximity of groundwater and marine resources to sources of contamination. The current method of solid waste disposal is collection by the local council who dump the waste in tipping sites located by the lagoon or ocean shore. The action of the tides and winds distributes the waste along the beaches creating an aesthetic, health and environmental problem.

The principal constraints to the satisfactory disposal of solid waste on Kiribati include the following:

- lack of available land for safe disposal of landfill material;
- susceptibility of groundwater and marine resources to pollution due to the relative proximity of the groundwater table and marine resources;
- lack of understanding of the causes and effects of pollution contamination;
- lack of readily available and locally understandable information;
- lack of effective legislation to control the disposal of toxic material;
- increasing volume of non-biodegradable material imported into the country;
- lack of legislative control mechanisms; and
- lack of implementation of existing legislation.

In a report prepared by the United Nations on urban refuse collection and disposal in Tarawa (UNDAT 1984), recommendations included the introduction of a recycling facility, the identification and establishment of new disposal sites, and the management of a refuse project with the two local councils (coordinated by the responsible government ministry). Only now is the issue being addressed through the actions of the recently established Environment Unit.

The concepts of waste recycling and reuse, and reduction of waste through controlled imports of non-biodegradable or non-recyclable goods will need to be encouraged as the disposal of non-biodegradable goods continues to occur, resulting in contamination and degradation of the environment.

7.3 Toxic and hazardous waste

The import of toxic and hazardous chemicals and substances into Kiribati is creating concern with regard to increasing usage and unmanaged disposal. In 1985 Kiribati imported chemicals to the value of approximately $US 850,000 (Stone 1990).

Chemicals are found in a number of goods used by private, commercial and government sectors. Products containing chemicals include dry cell torch batteries, lead acid batteries, pesticides and herbicides for agricultural and home use, and a range of chemicals used in commercial applications. Current usage patterns for dry cell batteries have been investigated. Gangaiya (1994) estimated that up to 4.5 million dry cell batteries per year are being imported. Considering the current disposal methods for batteries, there is concern that chemical leakage from batteries will lead to contamination of the groundwater and lagoon.

The list of pesticides available in Kiribati includes DDT found in some brands of mosquito coils. DDT is a chemical that is banned from use in the United States on health or environmental grounds (Greenpeace 1993). In a report by Watts (1993) regarding the presence of pesticides in Kiribati, it was stated that there was "unused Malathion (in bulk) on Kanton Island, left there after World War II by the U.S. Military".

The current disposal of used containers is either on-site storage, which may expose the containers to rainwater and lead to contamination of the groundwater, or disposal at the shoreline rubbish dumps, releasing the chemicals into the marine environment. At present there is no legislation to regulate the sale, use or storage of pesticides in Kiribati (Pulea & Farrier 1994).

The problems associated with toxic waste will continue to grow until the import and use of chemicals is controlled, or suitable storage or reprocessing of the containers is carried out under a waste disposal management system.

Sediments contaminated by hydrocarbon discharge adjacent to Betio slipway. (photo: Craig Wilson)

7.4 Coastal erosion

Widespread coastal erosion problems have been identified on islands throughout Kiribati (SOPAC 1993). The dynamic nature of atoll shorelines has been recognised (Woodroffe & McLean 1992). Wind and water constantly reshape the coastlines of all the atolls and islands of Kiribati. Such movement of beach sediments by natural forces is altered by the introduction of fixed structures. Poorly designed or constructed sea walls may contribute to erosion by simply shifting the impact of wave energy to another location rather than dissipating it.

Factors contributing to coastal erosion include:

- the construction and design of sea walls (depending on local conditions and the type of materials used);
- the removal of beach rock from the reef to construct sea walls thus lowering the level of the reef and allowing increased wave energy to be transmitted to the shoreline (Woodroffe & McLean 1992);
- the removal of sand and gravel from the beach sediment bank, robbing the shoreline of sediment; and
- the removal of mangroves and coastal vegetation, exposing the sediments to the action of wind and waves.

The effects of erosion could be magnified with an increase in sea-level rise as determined under the Intergovernmental Panel for Climate Change (IPCC) predictions for future sea-level rises. Sea-level rise in combination with an increase in ENSO activity, high tides and storm surges could lead to a more rapid and extensive alteration of the shoreline.

The protection of capital assets (land and buildings) from erosion will need to be weighed against the high costs of such protection. This will be of significant concern in South Tarawa where the majority of the population and greatest concentration of capital assets are located. On the outer islands the issue of land protection and/or relocation will need to be addressed through consultation with the community and through the development of land planning guidelines.

7.5 Causeway construction

The influence of causeway construction activities carried out over the previous thirty years has had a noticeable effect on the state of fish stocks and capacity for stock recruitment.

On Makin the construction of the causeway in the 1970s has resulted in the loss of mangroves and habitat areas for crab and shellfish populations. The causeway has reduced water flows to the lagoon resulting in an accumulation of decaying vegetation. With a loss of ocean flushing, the lagoon would be subject to lower salinity levels during periods of high rainfall and increased salinity during periods of low rainfall.

On Butaritari the construction of the causeway in the late 1980s has altered the previous fish migration paths. The resulting effect has been a change in the spawning habits of the lagoon fish and in the movement of fish larvae, an essential component of fish stock recruitment.

On Marakei, which was known as 'Aban te ika' or "The Land of Fish", the construction of the causeway at the Baretoa Passage has encouraged sediment accretion resulting in the severe restriction of water flow. This has resulted in a loss of fish from the lagoon through reduced recruitment, variable salinity levels, and a change in species diversity (Tebano 1991b).

On South Tarawa the construction of four causeways linking all the islets has lowered the flushing capacity of the lagoons resulting in accumulation of contaminated water on the lagoon reef flats, the contamination of edible molluscs from faecal contamination, and the loss of fish larval recruitment into the lagoon (Naidu et al. 1991).

7.6 Boat channel construction

Blasting techniques have been used in the Pacific for the construction of new boat channels and the widening of existing channels through the coral reefs to allow greater lagoon access since the 1930s. In a study to determine the ecological effects of blasting, Kaly and Jones (1990) found that it did not have widespread detrimental effects on the ecology of coral reefs. However, they stressed that a longer term study was needed to assess results with regard to ciguatera fish poisoning.

A survey carried out in Kiribati in 1983 to assess levels of ciguatera indicated that the number of islands and areas of reef producing toxic fish had increased over the 20 to 25 years prior to the survey (Tebano 1991a). Results of algal surveys indicate

the causative organism to be the dinoflagellate (*Gambierdiscus toxicus*). *G. toxicus* was common throughout the islands tested and found to be more common in the southern Gilbert Group. Medical records of incidence show that an increase in toxicity may be attributed to the practice of reef blasting and dredging in the creation of boat channels. Following the initial construction of a channel, the colonisation of the newly exposed surfaces by algae created the required habitat for *G. toxicus*. Subsequent grazing of the reef fish on the algae resulted in an accumulation in the reef fish of *G. toxicus* which was then eaten, resulting in consumer poisoning.

The assessment of fish poisoning in relation to reef blasting raises considerable doubt as to its efficacy as a construction technique and points to the need for fuller investigation.

7.7 Vegetation clearance

The removal of vegetation for fuel wood, especially in the higher population areas of South Tarawa, appears to be occurring at a rate that will severely deplete the available resource, leading to a loss in fuel-wood supply and the eventual loss of shade. Tree loss is a function of population demand and supply. Since the current tree preservation laws are not administered and no tree replenishment programmes are being carried out within the urban areas of South Tarawa, the loss is expected to continue.

7.8 Environmental awareness

In general, there is a lack of environmental awareness in regard to the effects on the environment of the influences of a Western lifestyle and associated imported goods. Access to information on the costs to the environment is not readily available to the broader community as few formal channels have been established to distribute what environmental information does arrive in Kiribati. As a result the community is unaware of the effects of their actions, and government is not able to effectively manage the impact of the activities that occur within the country.

7.9 Oil pollution

The ever increasing dependence on imported fossil fuels including oil, petrol, diesel and kerosene will lead to the importation of increasing volumes of hydrocarbon products. This will present increasing risks from pollution through transport and offloading operations, onshore storage, land transport and distribution and the storage of waste oils following use. Fortunately, no major oil spills have occurred in close proximity to the coastline of Kiribati. However, the sinking in May 1993 of a United States purse seine tuna boat 95 nautical miles to the west of Abaiang highlighted the ever increasing risk of a major oil spill.

Of great concern is the incidence of small-scale spills that occur during loading operations

Oil contamination at the Betio powerhouse. Continual small-scale discharge could result in groundwater contamination. (photo: Craig Wilson)

adjacent to shore-based storage facilities. While not excessive in size, the persistence of such spills over time will lead to an increasing level of contamination — contamination which is evident even now in poorly flushed areas of the boat harbour. The storage on shore of oil for local use, unless carried out in a managed way, will lead to problems as experienced at the Public Utilities Board electricity generation area where contamination of the ground and groundwater is apparent.

Until the issue of oil storage and waste management is addressed in conjunction with the implementation of energy conservation incentives, the potential for oil pollution will rise as the demand for oil imports increases.

7.10 Population and urbanisation

One of the consistent factors that appears throughout the discussion of local issues is the impact of population growth and rapid urbanisation on the environment. The rise in population on South Tarawa is leading to overcrowding, unemployment and housing shortages, which have resulted in social problems through development of squatter areas and continued pressure on natural resources. The distribution imbalance through South Tarawa has led to increasing pressure on the environment to absorb the impact of a rising population. This is most evident on Betio as groups of land-poor squatters appear, leading to overcrowding and a reduction in quality of life. The population rise will continue despite the best efforts of the government through family planning initiatives and resettlement schemes.

Population growth will continue to occur as:

- family planning programmes take considerable time to show fertility decline;
- the high proportion of young people (50 per cent of the population under the age of 15) provides a strong impetus for growth;
- any restriction on in-migration alone will not stop population growth; and
- out-migration to the outer islands through the resettlement schemes in 1978 did not significantly reduce population growth on South Tarawa (Jones 1993).

The urbanisation of South Tarawa and the lack of suitable land have led to illegal land settlements that have encroached onto water reserves and resulted in contamination of the groundwater by animal and human waste. Landowners who occupy lands that have been designated as water reserves also contribute to contamination of the groundwater reserves. The increasing population will lead to an increase in urbanisation and subsequent demand for land. To accommodate the estimated population rise more than 2,000 land plots will be required (Jones 1993). This is clearly a difficult task, considering the lack of available land due to finite supply, land fragmentation, and land tenure arrangements.

View of South Tarawa. (photo: Simon Diffey)

The pressure of population is also leading to deforestation as timber supplies for fuel wood come under increasing pressure. Similarly, the pressure of population on the fish and marine stocks of the lagoon, in combination with reduced recruitment because of causeway construction, is adversely affecting the capacity of the resource to supply food for the rising population.

Environmental conditions will continue to deteriorate on South Tarawa until the essential

questions of urban planning, economic development and environmental management are addressed both in the short and long term. The Ministry of Environment and Natural Resources Development, in conjunction with other ministries and community groups, has been active in promoting the importance of the natural environment in South Tarawa. A priority range of actions is currently being investigated.

An understanding of the South Tarawa situation should give rise to a determination to ensure that issues involving environmental management and land planning, as they relate to the outer islands, are addressed in a proactive manner.

7.11 Threats to wildlife

The Northern Line Islands contain areas of international conservation significance. Sea bird colonies on Kiritimati are under threat from the presence of feral animals such as cats and, to a lesser extent, pigs. Poaching of birds and eggs by the local community continues, despite existing protection legislation.

The presence of the rare and endangered scarlet-breasted lorikeet on Teraina and the threat to its survival from introduced rats and the expansion of the human resettlement programme will need to be assessed, if the lorikeet's preservation is to be ensured.

Marine turtles are classified as endangered on a worldwide basis due to the effects of the shell trade, meat and egg consumption, accidental catch in driftnets, and pollution (SPACHEE 1990). There are indications that green turtles are becoming scarce in the Gilbert Group (Thaman et al. 1992). Existing legislation to protect turtles is complex and, considering the endangered status of marine turtles, requires review. Legislation should take into account customary law as turtles are a traditional food source and considered a delicacy. Enforcement of regulations especially in the outer islands would require a widespread education campaign and increased community consultation.

7.12 Plant and animal quarantine

Protection from the introduction of exotic pests and diseases to Kiribati will be an increasing requirement as the volume of imported material from all parts of the world increases. The introduction of termites in untreated timbers and the presence of the breadfruit mealybug are just two examples of pest introduction that would have a detrimental effect on agricultural aspects of the environment.

7.13 Environmental education

Environmental programmes are included in the curriculum for primary schools but many of the schools are restricted by the lack of appropriate resource materials and by a focus on Common Entrance Examination subjects to the detriment of other subjects.

In the secondary school system there are no specific environment subjects. However, aspects of the natural and social environment are dealt with in a number of related subjects at different levels in the curriculum.

At tertiary level, the lack of resources relating to environmental issues acts as a constraint to wider understanding of environmental processes and the effect that the change of lifestyle is also having on the environment.

Further details on environmental education in Kiribati are contained in Taylor (1994).

7.14 International issues

7.14.1 Global warming and sea-level rise

Global warming of the atmosphere from the release of greenhouse gases (particularly carbon dioxide) is predicted by the Intergovernmental Panel on Climate Change (IPCC) to lead to a rise in sea level of 30 to 50 cm by 2050, and about 100 cm by 2100 (IPCC 1990). The effects of sea-level rise in combination with ENSO events would have a major impact on the low-lying atolls and islands of Kiribati.

Potential effects include an increase in tropical cyclones as the major climate pressure belts are displaced, the inundation of low-lying atolls and islands, salt-water contamination of the fresh-water lenses, increased coastal erosion, an increase in coral mortality and subsequent loss of fisheries resources. While the cause of these events has originated from the developed countries, the effects will be felt first in the low-lying atolls of the Pacific.

It is important that Kiribati voice its concerns at the international level whilst anticipating mitigative and adaptive responses to address global problems.

7.14.2 Radiation testing and transport

The use of Kiritimati Island for atmospheric testing of nuclear devices by the United Kingdom in the 1950s and the United States in the 1960s has led to concerns that areas of the island may exhibit levels of radiation contamination that constitute a health hazard. Studies carried out in 1964 and 1975 stated that no hazard remained on Kiritimati Island from radiation contamination. Following concerns raised by the Director of the former Centre for Applied Studies in Development of the University of the South Pacific in regard to hazard levels, an independent survey was carried out by the New Zealand National Radiation Laboratory which stated that no site on the island was found to present a risk to the health of the resident population (AGRICO 1993). However, with regard to contamination levels and what constitutes acceptable methods of testing and result interpretation, the contentious issue of nuclear testing in the Pacific remains.

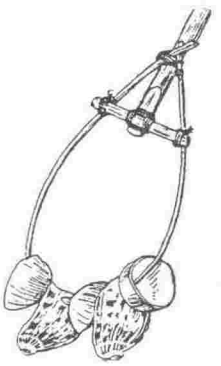
Recently, the transport of plutonium from France to Japan through the waters of the Pacific against the expressed wishes of the Pacific nations clearly illustrates the concern at having a potential nuclear disaster within the region.

7.14.3 Dumping of toxic waste

The practice of industrialised countries dumping toxic waste in developing countries is of great concern to the Pacific nations. In November 1992 a shipment of petroleum-contaminated soil from the United States was refused entry to the Marshall Islands where it was planned to use the waste for causeway construction (Greenpeace 1993). The control of imports into Kiribati will need to be monitored to ensure that it is not the unknowing recipient of toxic waste from other countries.

Chapter 8

Responses to environmental issues



8.1 Government initiatives

The Government of Kiribati has made the first and most important step by recognising the need for sustainable development to ensure that the natural resources of Kiribati are maintained in good condition for use by future generations of I-Kiribati. Kiribati's Seventh National Development Plan 1992–1995 states:

> Continued national commitment is crucial to the protection of the environment against pollution, degradation and depletion of resources. Environment and development are directly associated in view of the overall focus on sustainability and improved quality of life. (Republic of Kiribati 1993)

Now that the government has committed itself to the goal of environmental protection, it will need to follow up with the coordinated activities of all government departments. The Kiribati Task Force on the Environment has been founded and an Environment Unit within the Ministry of Environment and Natural Resources Development established. The Environment Unit has the task of implementing the objectives of the government with regard to sustainable development.

The Environment Unit plans to adopt a two-level approach.

(1) The first is 'top down' — implementing the initiatives of parliament to coordinate the operations of all government departments in the implementation of development projects. This is to ensure the community is the receiver of benefits through the achievement of sustainable development.

(2) The second approach is 'bottom up' — encouraging the community to become involved in the environmental management process through consensus and consultation. This will occur through home, school and office-based activities to raise public awareness of environment-related issues.

The effectiveness of the two-level approach will be determined by the response of government to ensure that initiatives for sustainable development are generated from within existing government structures as well as from external funding.

8.2 Land use planning and management

Land use planning is the responsibility of the Lands and Survey Division of the Ministry of Home Affairs and Rural Development under the provisions of the *Land Planning Ordinance 1973*.

One of the principal functions of the Division is the update of the General Land-use Plan. The first stage of the process is the preparation of a strategy plan for Betio which is currently being reviewed by government before being released for general comment (MHARD 1994). The strategy plan will define zones for suitable development and will ensure both that the process of land planning incorporates the principles of community consultation and that the state of the environment becomes an integral component of the land planning process.

The social and cultural importance of land is well recognised in Kiribati. It is also recognised that land is becoming a scarce resource, particularly in South Tarawa. The demand for land from a rising population has resulted in an increased rate of urbanisation, the emergence of land-poor squatters, and a reduction in the capacity of the land to cope with such a large and recent influx of people. It will be the responsibility of the government to

ensure that the land planning process is developed and implemented throughout South Tarawa, and to ensure that the principles of land planning and environmental management resulting in sustainable development are also implemented in the outer islands.

8.3 Legislation

8.3.1 General

The implementation of new legislation and coordination of existing legislation will play a major role in responding to the challenges of environmental management.

The effectiveness of legislation in responding to environmental issues is governed by a range of factors:

(1) Legislation needs to be current and adaptable to allow for the rapid changes occurring within the environment.

(2) Legislation needs to reflect the consensus of public opinion through debate and consultation with the community.

(3) Legislation needs to incorporate customary law as the outer island people lead a more traditional lifestyle of which traditional laws and customs are still an integral part.

(4) Legislation needs to be supported by an effective, government-based regulation system that works through cooperation rather than coercion.

When these factors are addressed, a basis of understanding can be established between the community and those who govern — an important requirement if the goals of sustainable development are to be achieved.

Kiribati does not have specific legislation relating to coordinated protection of the environment for sustainable development. Currently, there are a range of statutes and by-laws that provide control over the activities that occur within Kiribati. The laws, statutes and by-laws are found in the Constitution; Ordinances and Acts; Common Law of Kiribati and customary law.

8.3.2 Existing legislation

Land or resource use and management

- *Native Lands Ordinance 1957* relates to native land and registration of titles.

Traditional mat weaving. (photo: Cait Wait)

- *Neglected Lands Ordinance 1957* provides for the purpose of neglected land and to regulate its sale to indigenous peoples.
- *Mineral Development Licensing Ordinance 1978* regulates the granting of licences for exploration and extraction.
- *Prohibited Areas Ordinance 1957* allows certain islands and their territorial waters to be declared prohibited areas.
- *Land Planning Ordinance 1973* provides for the control of the development and use of land.
- *Marine Zones (Declaration) Act 1983* makes provision in respect of the internal waters, archipelagic waters, the territorial sea, the Exclusive Economic Zone (EEZ) and the contiguous zone of Kiribati.
- *Public Highways Protection Act 1989* makes provision for the protection of public highways.
- *Fisheries (Pacific Island States' Treaty with the United States of America) Act 1988* gives effect

to the *Treaty on Fisheries between the Governments of Certain Pacific Island States and the Government of the United States of America 1987.*

Coastal management and protection

- *Foreshore and Land Reclamation Ordinance 1969* declares ownership of the foreshore and regulates activities within the foreshore.

Conservation of strategic or endangered marine and terrestrial resources

- *Wildlife Conservation Ordinance 1975* provides for the conservation of wildlife.
- *Plants Ordinance 1976* provides for the protection of endangered or culturally important plant species.
- *Fisheries Ordinances 1977* makes provision for the regulation of fishing and fisheries industries and provides for the protection of specified fish species in Kiribati and within the EEZ.

Water, sanitation and health

- *Quarantine Ordinance 1931* regulates the importation of agricultural and other products which may harbour insects and pathogens.
- *Public Health Ordinance 1926* maintains adequate standards of public health.
- *Importation of Animals Ordinance 1919* regulates the importation of animals.

Control of specific potentially polluting, dangerous or environmentally disruptive substances and materials

- *Wrecks and Salvage Ordinance 1966* provides for rights to wrecks and salvage.
- *Merchant Shipping Oil Pollution Gilbert Islands Order 1975* applies provisions of the *U.K. Nuclear Installations Act of 1965.*
- *Nuclear Installations Gilbert and Ellice Islands Order 1972* applies provisions of the *U.K. Nuclear Installations Act of 1965.*

Local Government Act 1984

This Act provides for the establishment of local government through island and town councils who enact by-laws relating to a range of areas including agriculture, fisheries, public health and other related topics.

The enactment of laws to guide the actions of the people especially in remote and isolated areas will require the cooperation of the people with regard to observance. The will of the island councils to enforce such regulations appears lacking in areas of environmental concern due to shortage of personnel and inappropriateness of the laws. For laws to work they need the cooperation of the local people to ensure that the environment is afforded the appropriate protection.

The government in its Seventh National Development Plan 1992–1995 under environmental objectives intends "to improve administrative arrangements and legislation".

8.3.3 International conventions

The Government of Kiribati, in recognition of its vulnerability to potential hazards posed by global problems, has been involved in the negotiation of international conventions which relate to environmental concerns affecting Kiribati. Kiribati has recognised the importance of such conventions and has participated either as an individual country or in collaboration with other Pacific Island nations through regional organisations.

Kiribati is a signatory or has acceded to the following environment-related conventions:

- *South Pacific Nuclear Free Zone Treaty, 1985* (Rarotonga Treaty)
- *Treaty on Non-proliferation of Nuclear Weapons, 1968*
- *Convention for the Prohibition of Fishing with Long Driftnets in the South Pacific, 1989* (Wellington Convention)
- *Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972* (London Dumping Convention)
- *Convention for the Protection of the Ozone Layer, 1985* (Vienna Convention)
- *United Nations Convention on the Law of the Sea, 1982*
- *United Nations Convention on Climate Change, 1992,* Rio de Janeiro

International fora

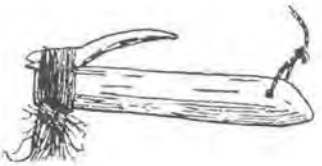
With regard to international conventions, Kiribati now has the opportunity to present its position on environmental matters to the global fora. Kiribati needs to clearly identify its objectives and strategies if it is to gain maximum benefits from such an opportunity and enhance its effectiveness in the international arena.

8.4 Non-government initiatives

As yet there are no non-government organisations (NGOs) in Kiribati that deal exclusively with environmental matters. However, there are existing organisations that deal with some aspects of the environment within their operations. The Foundation for the Peoples of the South Pacific (FSP) works in agricultural and health areas, and Aia Maea Ainen Kiribati (AMAK), the Kiribati women's group, is concerned with public health issues of the community. The many church and youth groups also deal with aspects of the environment within their programmes. The capacity of existing NGOs needs to be developed, and the possible formation of an environment-specific NGO considered, as the involvement of the community is an integral part of effective environmental management.

Chapter 9

Conclusion



Environmental management requires a far-sighted approach by government as measures to protect the environment show few short-term benefits. Past I-Kiribati culture encouraged long-term perspectives that were encompassed in genealogical traditions. Therefore, the introduction of long-term environmental management practices should be readily accepted by the community provided it is an active participant in the decision-making process. The people of Kiribati achieved this in the past through their established subsistence lifestyle. Now the challenge for the future of Kiribati will be to incorporate the influx of Western ideas and goods while still maintaining a lifestyle that encompasses the good of all I-Kiribati. The process of change will be influenced by the Kiribati government and its ability to acquire sources of funding assistance that are appropriate to its ideas and stated aims. The task of safeguarding the Kiribati environment can best be achieved through the cooperative efforts of all levels of government and sections of the community. The wisdom of government at this point in time will be reflected in the quality of the environment in the future.

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Managed areas, wildlife sanctuaries and reserves

(established under the Wildlife Conservation Ordinance 1975)

Line Islands

Kiritimati Sanctuary
Cook Islet Reserve
Motu Tabu Reserve
Motu Upua Reserve
Ngaon te Taake Islet Reserve
North–West Point Reserve

Malden Island Sanctuary
Starbuck Island Sanctuary
Vostock Island Sanctuary

Phoenix Group

Birnie Island Sanctuary
McKean Island Sanctuary

Source: Guinther et al. 1992.

Appendix 2

Endangered and endemic species

Indigenous or endemic

83 indigenous plants
5 indigenous lizards
23 indigenous breeding sea birds

Threatened or endangered

Endemic Christmas Island Warbler — Tabueran, Teraina, Kiritimati
Black coral
Coconut crab
Triton's trumpet snail, *Charonia tritonis*
Corallium spp.
100 spp. of indigenous reef coral
Pinctada sp.
Hippopus (2 spp.)
Tridacna (4 spp.)
Green snail
Green turtle (nesting and feeding areas)
Hawksbill turtle (feeding areas)
'Tuamotu' sandpiper (endemic to central Pacific)
Scarlet-breasted lorikeet (introduced)
Blue whale
Sperm whale
Southern right whale
Fraser's dolphin
Tropical spinner dolphin

Source: Guinther et al. 1992.

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