

INITIAL NATIONAL COMMUNICATION

Under the
**United Nations Framework
Convention on Climate Change**

October 1999
Revised Edition, March 2000

**Cook Islands
Initial National Communication**

Under the

**United Nations Framework
Convention on Climate Change**

October 1999

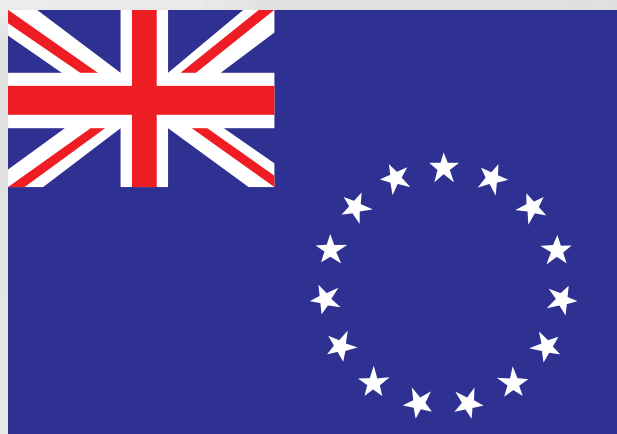
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Initial National Communication Of the Cook Islands

Under the

**United Nations Framework
Convention on Climate Change**

October 1999

FOREWORD



GOVERNMENT OF THE COOK ISLANDS
MINISTER FOR ENVIRONMENT

Foreword

I am pleased on behalf of Government to extend our appreciation and support for the efforts of the talented and experienced team of Cook Islands people on the Pacific Islands Climate Change Programme (PICCAP) Country Team, in coordinating the input on this most important of issues - global climate change and sea level rise - and the effects it will have physically and socially in the Cook Islands.

In this respect, this Initial Communication will assist Government and its agencies, and the people of the Cook Islands in developing and administering policies in areas vital to the sustainability of our future. Particularly so, when we live in a country that is vulnerable to the slightest climatic change.

In particular I refer to our natural environment - the beautiful shoreline, the clear lagoon waters, and vibrant fauna - so valuable to our tourism industry, the mainstay of our economy.

A special appreciation is extended to the South Pacific Regional Environment Programme (SPREP) for its financial and technical input, to ensuring the completion of this document through associated PICCAP initiatives. The outcome of which has enabled our Government to identify how best to minimise the likely adverse effects of climate change.

I am optimistic that the outcome of the Cook Islands Initial National Communications will go a long way in assisting the country to better manage the effects of climate change more effectively, for the betterment of the Cook Islands environment, and our way of life which we hold so dear.

Kia Manuia

A handwritten signature in cursive script that reads "Norman George".

Hon. Norman George
**DEPUTY PRIME MINISTER and
MINISTER FOR ENVIRONMENT**

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GLOSSARY

Ariki	The person invested with the traditional title or rank of office of Ariki (chief)
Aronga Mana	A group of traditional leaders
Koutu	Investiture sites
Koutu Nui	Meeting or gathering of traditional leaders
Makatea	Raised coral
Maire	Hawaiian Maile, Foliage garland
Maori	Indigenous people to the Cook Islands or indigenous language to the Cook Islands
Marae	Meeting place
National Retreat	Meeting of representatives of government and all sectors of the community
Noni	Morinda Cirtrifolia
Ra'ui	Traditional method of conservation
Paepae	House sites
Pawpaw	Hawaiian papaya
Tapa	Traditional cloth made of tree bark
Tarua	Xanthosoma
Te Aponga Uira O Tumutevarovaro	Rarotonga Power Supply
Tutaka	Environmental health inspection carried out by the Department of Public Health
Ui Ariki	Group of Ariki

LIST OF ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank
AWS	Automatic Weather Station
CH ₄	Methane
CINHP	Cook Islands Natural Heritage Project
CISB	Cook Islands Savings Bank
COP	Conference of the Parties
CO ₂	Carbon Dioxide
DIB	Development Investment Board
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
ENSO	El Nino Southern Oscillation
ERP	Economic Reform Programme
FAO	Food and Agriculture Organisation
GCM	Global Circulation Model
GDP	Gross Domestic Product
GEF	Global Environment Facility
Gg	Gigagrams
GHG	Green House Gases
GIS	Geographic Information System
GMT	Greenwich Mean Time
GOES – 10	Geo-stationary Operational Environmental Satellite
HADCM	Hadley Circulation Model
IPCC	Intergovernmental Panel on Climate Change
LPG	Liquid Petroleum Gas
NGO	Non Governmental Organisation
NOAA	National Oceanic and Atmosphere Administration
N ₂ O	Nitrous Oxide
PICCAP	Pacific Islands Climate Change Assistance Programme
SOPAC	South Pacific Applied GeoScience Commission
SPCZ	South Pacific Convergence Zone
UNCBD	United Nations Convention on Biological Diversity
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework on Climate Change
USP	University of the South Pacific
V&A	Vulnerability and Adaptation
WHO	World Health Organisation
WMO	World Meteorological Organisation

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

INTRODUCTION

The preparation of the Cook Islands Initial National Communication was funded by the Global Environment Fund Climate Change Enabling Activity through the Pacific Islands Climate Change Assistance Programme (PICCAP).

The initial communication is a culmination of activities undertaken by Cook Islanders since November 1997. A national country team was established with the support of government agencies and a PICCAP co-ordinator was appointed. Cook Island consultants were identified to undertake field studies, compile information and prepare the country's first reports on the national inventory of greenhouse gas sources and sinks as well as the national assessment of vulnerability to climate change and sea level rise.

Capacity building activities included learning how to scientifically assess likely vulnerability and adaptation options at the International Global Change Institute (IGCI) based at Waikato University in New Zealand and the University of the South Pacific in Suva, Fiji. Many other opportunities to support technical training and capacity building of Cook Island nationals has been available through the UNITAR CC Train programme.

The national communication is presented in four sections:

- National Circumstances
- National Inventory of Greenhouse Gases
- Vulnerability and Adaptation
- Cross Sectoral Measures

NATIONAL CIRCUMSTANCES

The Cook Islands like other small islands is a combination of low-lying islands, atolls and volcanic high islands. They lie within the extensive and persistent trade wind zone of the South Pacific and are free from the influence of large land masses or continents. The islands enjoy a mild maritime climate with a pronounced wet season (November to April) where two thirds of the annual rain falls, and a dry season (May to October).

The population and economic activities are concentrated in the coastal zones and therefore vulnerable to climate change or the potential impacts of sea level rise. Tourism is the Cook Islands major income earner and is reliant on the islands natural beauty. Adverse climate conditions causing temperatures to rise could have a major impact on this fragile tourist based economy. Other economic activities such as agriculture and fisheries remain small contributors to the national cake but still play a major role in supplying local market needs and ensuring balanced diets are maintained.

Marine resources are one of the Cook Islands least exploited natural resources. The production of and farming of black pearls and pearl shell from the northern group islands is the second most important sector after tourism and is forecast to increase substantially over the next 10 years.

Electricity generation for the Cook Islands is heavily dependent on

imported petroleum products. The Government is committed to providing all households with 24 hour electricity and today 98 percent of homes in the Cook Islands have electricity.

Water resources are a major concern for the Cook Islands with no water reservoirs available on any of the 15 islands. The main source of water is from stream, roof catchment systems, boreholes and private or community water tanks.

The biodiversity of the Cook Islands is relatively small with indigenous flowering plants and birds mainly in the southern group islands and fewer numbers in the northern group where there is decreasing habitat complexity.

This section demonstrates the fragility and critical nature of our small nation that requires continued support if Government is to recognise as a high priority the need to protect the environment for sustainable development.

NATIONAL INVENTORY FOR GREENHOUSE GASES

The Cook Islands Inventory for Greenhouse Gases has been calculated for the year 1994 and is limited to the best information available. It is noted that although IPCC guidelines have been followed this approach has been modified to account for the fact that the IPCC guidelines do not fully capture issues of scale for small island developing states and the unique characteristics of the Cook Islands.

Greenhouse Gas emissions for the Cook Islands are Carbon dioxide 32.564Gg, Methane 0.504Gg and Nitrous Oxide 0.1198Gg. These are very small per capita emissions and therefore a reduction would not be noticeable or have little impact to the average person.

Identified mitigation options for the Cook Islands includes, promotion for energy efficient appliances, renewable energy and ground transport improvement.

The study has highlighted the need for further training in statistical data collection and maintenance to improve the Cook Islands reporting obligations.

VULNERABILITY AND ADAPTATION

The National Vulnerability and Adaptation Statement is an initial assessment and overview of the Cook Islands vulnerability to climate change and sea level rise.

It is recognised that development and social changes have placed pressure on sensitive environmental systems and sectors of the Cook Islands and therefore adverse impacts of anticipated changes in climate and sea level rise will further exacerbate the stress on these systems if they do eventuate. Due to the lack of quantitative data, the limited scientific capabilities, limited studies or absence of previous literature qualitative statements are made. The vulnerable sectors identified in this statement are agriculture and food security, coastal zone and coral reefs, marine

EXECUTIVE SUMMARY

resources, water resources and biodiversity. The likely impacts on these sectors can be summarised as follows:

Urbanisation has reduced the availability of good agricultural land and for small atolls these low lying areas will require special alternative systems of cultivation, and salt resistant crops.

It will be essential to manage development more closely to increase the resilience of sensitive coastal areas and foreshores so thereby reducing vulnerability when extra stress from climate change or sea level rise occurs.

Control of waste, run off and pollutants in coastal and marine areas should be better controlled. Ground water resources should be further investigated.

All these measures would be enhanced with a public awareness programme to improve environmental awareness generally and support the need to understand changes that would occur due to human activity and influences as well as climate or sea level related changes.

For the Cook Islands to respond successfully and implement appropriate adaptation strategies each major sector has identified information gaps and capacity building requirements that must be addressed.

CROSS SECTORAL MEASURES

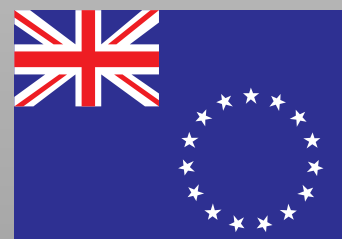
The measures that will be undertaken by the Cook Islands, which will have, cross cutting implications for all of the vulnerable sectors identified. These measures will support all mitigation and adaptation options to be implemented. They include policy measures, research and education and awareness.

Incorporation and main streaming of climate change and sea level rise issues into government policy is ongoing and will take time to achieve.

Adaptation and mitigation strategies for the Cook Islands will be based on an integrated and comprehensive approach, which encompasses the health and well being of the nation. Local communities should be involved at all stages of the development of adaptation programs. The lead sector should be coastal and marine areas and an adaptation plan, to be part of a climate change action plan, should be drafted, implemented, monitored and regularly updated.

Current economic development objectives are based on the national aspiration to increase the per capita income of all Cook Islanders and to share in the productive sectors of the economy. This is a shift from a policy of dependence to one of self-reliance. The current developmental objectives take greater account of the potential of human resources to increase productivity and utilise the private sector as the engine to drive the economy.

The National Communication concludes that a national adaptation strategy in the Cook Islands should follow a 'no-regrets' approach. Such an approach would prioritise the development and implementation of policies and measures which are beneficial for both the environment and the well being of the Cook Islands even in the absence of climate and sea-level change. Stronger measures must be adopted in the management of the environment to reduce the risk of climate change, which will be difficult to predict and therefore manage. All these measures should be integrated into economic planning and implemented through an integrated and comprehensive approach.



Chapter 2

NATIONAL CIRCUMSTANCES

NATIONAL CIRCUMSTANCES

NATIONAL CIRCUMSTANCES

2.1. BACKGROUND

The Cook Islands comprises 15 small islands scattered over some 1.8 million sq. km of the South Pacific Ocean between Samoa and Tonga on the west and French Polynesia on the east. Their location is between latitudes 9 degrees and 22 degrees south and longitudes 157 degrees and 166 degrees west. The islands are divided geographically along a line between Palmerston and Suwarrow into a Northern Group (six islands) and a Southern Group (nine islands).

The land area is 240 sq. km with over 88 per cent (214 sq. km) of the land area in the Southern Group.

The Exclusive Economic Zone (EEZ) of the Cook Islands is 1.8 million square kilometers of the South Pacific Ocean.



Figure 2.1 Location Map



NATIONAL CIRCUMSTANCES

2.2. GEOGRAPHY

The islands represent the five different island systems found in the Pacific Basin: high volcanic; low volcanic surrounded by a raised reef platform or makatea, volcanic partially submerged with a large atoll-type lagoon or almost-atoll; the true atolls; and sand-cays. Some environmental features of each island are summarised in Table 2.1: Island Environmental Features

The low-lying islands have a height range above mean sea level of 5 to 9 meters. Rarotonga is both the largest island (67.2 sq. km) and the highest island (652 meters above mean sea level). With the exception of Manuae and Takutea all islands of the Cook Islands are inhabited.

2.3. HISTORY

The Cook Islands became a British Protectorate in 1888 administered by New Zealand and annexed to New Zealand in 1901. The Cook Islands became a self-governing state in free association with New Zealand in 1965 under the Cook Islands Constitution Act 1964 and the Cook Islands Constitution Amendment Act 1965. The severing of formal ties to New Zealand brought to a close the power to direct the internal affairs of the Cook Islands. The Cook Islands can, at any time move to full independence by a unilateral act if it so desires.

Her Majesty the Queen Elizabeth II in Right of New Zealand is the Head of State of the Cook Islands. The Queens Representative who is appointed on the advice of the Cook Islands Government, represents her Majesty in the Cook Islands.



Cook Islands Legislative Assembly Building, Rarotonga

2.4. GOVERNANCE

The Parliament of the Cook Islands consists of 25 members elected by secret ballot under a system of universal suffrage. The Constitution makes provision for representation in Parliament from nearly all the islands. The 1980-81 Constitutional amendments created an overseas constituency, which includes New Zealand and all other areas outside the Cook Islands.

A cabinet of ministers, comprising the Prime Minister and up to five other Ministers, appointed from amongst members of Parliament, as well

as a provision for one additional Minister who is not a member of Parliament to be appointed, will have the general direction and control of the Executive Government and are collectively responsible to Parliament. The Prime Minister is appointed by the Queen's Representative, being the Member of Parliament commanding the confidence of the majority of members. The other Ministers are appointed on the advice of the Prime Minister.

2.5. CENTRAL GOVERNMENT

Rarotonga is the main island of the Cook Islands. The capital Avarua on Rarotonga is the central seat of government and the center of commerce. Tourism activity is based primarily in Rarotonga while Aitutaki is a secondary stop.

2.6. LOCAL GOVERNMENT

The Outer Islands Local Government Act 1988 applies to all islands except Rarotonga. The Island Councils administer this Act on each Island. Membership of an Island Council consists of the traditional chiefs, Ariki or the Ui Ariki of the Island, a representative of the Aronga Mana (senior citizens) of the Island, the members of Parliament of the Island and the elected members of the island council constituencies for each island.

A system of local government for Rarotonga was reactivated in 1997 with the passage of the Rarotonga Local Government Act². The first elections for Mayors and Councillors took place in November 1998.

The Island Councils are permanent bodies capable of owning and disposing property. They will assist in the co-ordination of any activity relevant to the economic and social development of each island and assist the Government of the Cook Islands in the good rule and government of the islands.

2.7. TRADITIONAL LEADERS

The Constitution provides for the establishment of the House of Ariki (chiefs). The House of Ariki Act 1966 and its amendments supplement the provisions of the Constitution. The House comprises eight Ariki representing the Outer Islands and not more than six appointed to represent Rarotonga and Palmerston. The function of the House is to consider matters relating to the welfare of the people of the Cook Islands as may be submitted to it by Parliament and to express its opinion and to make recommendations thereon. It may also make recommendations to Parliament on any question affecting the customs and traditional practises of the Cook Islands.

A further traditional body has been established by Government known as the Koutu Nui. This provides the Mataipo and Rangitira (sub chiefs) of each of the tribes to also have a voice in the decision making process of government.

2.8. CLIMATE

The Cook Islands lie within the extensive and persistent trade wind zone of the South Pacific and are free from the influence of large land masses or continents. The islands enjoy a mild maritime climate with a pronounced wet season (November to April) where two-thirds of the annual amount falls, and a dry season (May to October).

¹ Cook Islands Review of Environmental Law 1992

² An Act to provide for a system of Local Government on the Island of Rarotonga, 1997, No. 10.

NATIONAL CIRCUMSTANCES

Table 2.1 Island Environmental Features

SOUTHERN GROUP	ISLAND TYPE	AREA (km²)	MAX ELE. (m)	PRINCIPAL NATIVE HABITATS	HABITATS OF MAJOR CONSERVATION SIGNIFICANCE
Rarotonga	High Volcanic	67.2	652	Strand vegetation Coastal forest (almost completely replaced by agriculture and houses) Wetlands (extensively modified by agriculture) Fernlands (probably a Secondary habitat) Inland Forest Cloud forest	Inland Forest Rarotonga Flycatcher Breeding range Petrel nesting range (4 Species) Location of rare plants within forest – well known by Cook Islands National Heritage Project Tidal salt marsh (Ngatangia Harbour)
Mangaia	Makatea	51.8	169	Makatea Forest Wetlands-modified by agriculture Fernlands (probably a secondary habitat); Inland forest; Cloud Forest.	Makatea Forest Freshwater Lake (Lake Tiriara)
Aitutaki	Almost Atoll	18.1	124	Strand vegetation Lowland Forest (greatly modified by agriculture) Wetland – saltmarsh	Wetland – saltmarsh
Atiu	Makatea	26.9	72	Makatea Forest Wetlands (greatly modified by agriculture) Freshwater lake Fernlands (probably a secondary habitat)	Makatea Forest Freshwater lake (Lake Tiroto)
Mauke	Makatea	18.4	29	Makatea forest Wetlands (greatly modified by agriculture) Fernlands (probably a secondary habitat)	Makatea forest
Mitiaro	Makatea	22.3	15	Makatea forest Wetlands (modified by agriculture) Freshwater Lakes	Makatea Forest (Dwarf Makatea Forest); Freshwater Lakes (Lakes Rotonui and Rotoiti) Peat swamps
Manuae	Atoll	6.9	10	Strand vegetation	Turtle nesting sites
Takutea	Sand Cay	1.2	5	Strand vegetation	Seabird nesting island – very significant and protected by land-owners
Palmerston	Atoll	2.0	5	Strand vegetation	Seabird and Turtle nesting sites
NORTHERN GROUP					
Penryhn	Atoll	9.8	5	Strand vegetation	Seabird and Turtle nesting sites
Manihiki	Atoll	5.4	5	Strand vegetation	Seabird and Turtle nesting sites
Pukapuka	Atoll	4.3	5	Strand vegetation	Seabird and Turtle nesting sites
Rakahanga	Atoll	4.1	5	Strand vegetation	Seabird and Turtle nesting sites
Nassau	Sand cay	1.2	9	Strand vegetation	Seabird and Turtle nesting sites
Suvarrow	Atoll	0.4	5	Strand vegetation	Seabird and Turtle nesting sites Gazetted as a National Park in 19781

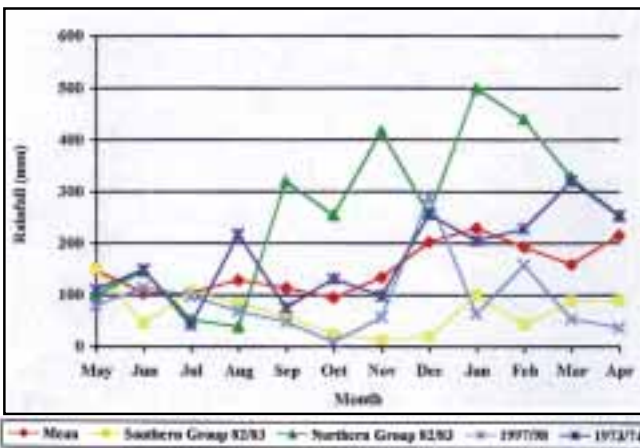
Sources: Rongo 1993, Scott 1993; Mc Cormack 1992; IUCN 1991; Dahl 1986

NATIONAL CIRCUMSTANCES

The Cook Islands are characterised by persistent trade winds throughout the year except when they are threatened by depressions or tropical cyclones during the summer periods or the wet season. The trade winds are stronger and more persistent in winter when strong anticyclones pass to the south of the group. In summer, the trades are weaker as the subtropical anticyclones become less intensive and migrate towards the south.

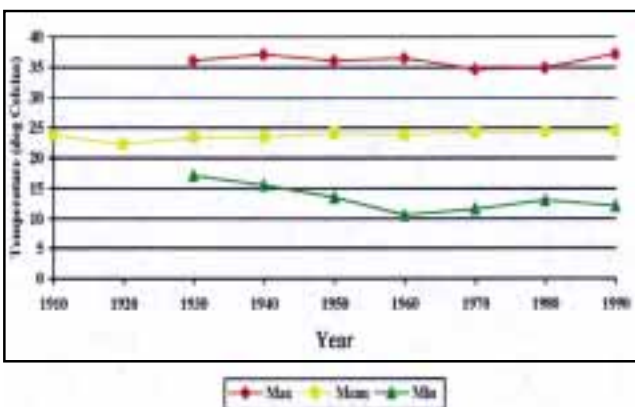
The climate of the Cook Islands is tropical and is dominated by easterly trade winds. There is a marked season in the rainfall regime where a dry season consisting of only a third of the 2000mm of annual rainfall occurs (May to October) while the other two-thirds occurs during the wet season (November to April). This wet season is also the tropical cyclone season associated with the easterly shift of the South Pacific Convergence Zone (SPCZ) over the country.

Figure 2.2: Comparison of Rainfall Patterns in the Cook Islands



The average temperature ranges from 21°C – 28°C throughout the year but extremes (i.e., maximum and minimum) have been recorded in the mid-thirties and mid-teens, respectively as illustrated in Figure 2.3. The climate is also influenced fairly strongly by the large inter-annual variation and El Nino-southern oscillation (ENSO) phenomenon.

Figure 2.3: Cook Islands Temperature



2.8.1. Weather Systems that affect the Cook Islands

The tropical cyclone season officially starts on 1 November and ends on 30 April. Cyclones tend to form to the far west of the northern Cook Islands and move erratically towards the south and normally after reach-

ing latitude 15 south, they tend to take a south easterly track. During El Nino episodes, these cyclones tend to develop in the Northern Group and move onto French Polynesia. During ENSO, the Southern Group experience a reduction of rainfall by (up to 60%) of the annual rainfall of 2000mm while in the Northern Group, the annual rainfall of 2300mm increases (up to 200%). This situation is reversed during the La Nina episode whereby the Northern Group would have a reduction in their normal rainfall while the Southern Group would have an increase in their normal annual rainfall.

2.8.2. Formation and Classification of Tropical Cyclones

The Cook Islands average about three cyclones in every two years but there are also cyclone-free seasons. Tropical Cyclones frequently develop in a trough of low pressure in the zone of cyclonic wind shear characterising the South Pacific Convergence Zone (SPCZ). Tropical Cyclones seldom form within 300 kilometres of the Equator where the Coriolis parameter is small, or in the zones of strong vertical shear such as beneath jet streams. Although tropical disturbances may occur all year round, tropical cyclones are usually confined to the warmer months, November to April.

These cyclones are named on reaching gale force intensity.

Table 2.2: Classification of Tropical Cyclones

Strength	Wind speed range (knots)
Gale force	34-47 (63-87 km per hour)
Storm force	47-63 (88-117 km per hour)
Hurricane force	> 63 (>117 km per hour)

Tropical Cyclone Martin caused extensive damage to property and infrastructure and brought human suffering through loss of lives during the 1997/98 ENSO. Tropical cyclone Pam also occurred during ENSO and although the damage was minimal, 213 mm of rain fell in a time span of six hours on Rarotonga, breaking a long period of drought. The rest of the southern group of islands experienced prolonged drought periods during the same time.

2.8.3. Tracking of Tropical Cyclones

Tropical cyclones are tracked through satellite imageries: the NOAA polar orbiting satellite and the GOES-10 geo-stationary satellite. These tracks are conveyed to the Cook Islands Meteorological Service by the Regional Specialised Meteorological Centre in Nadi, Fiji through a Special Weather Bulletin. When a tropical cyclone nears the Cook Islands, a Tropical Cyclone Tracking Map is used based on an alphanumeric system. This map identifies a grid as the community can relate to a grid on a map rather than a longitudinal and latitudinal position given in the Special Weather Bulletin.

2.8.4. Cyclone Warning System

Whenever a tropical cyclone threatens the Cook Islands, cyclone warnings are issued to enable inhabitants to take necessary precautions. The cyclone warning system comprises of four warnings.

- Tropical Cyclone Alert:** 24-48 hours before the Cook Islands is likely to be affected
- Gale Warning:** 6 hours before the expected occurrence of gale force winds
- Storm Warning:** 3 hours before the expected of storm force winds
- Hurricane Warning:** 3 hours before the expected hurricane force winds

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These warnings are disseminated through the radio, television, telephone/fax and the *Cook Islands News*.

2.9. POPULATION AND SOCIAL SITUATION

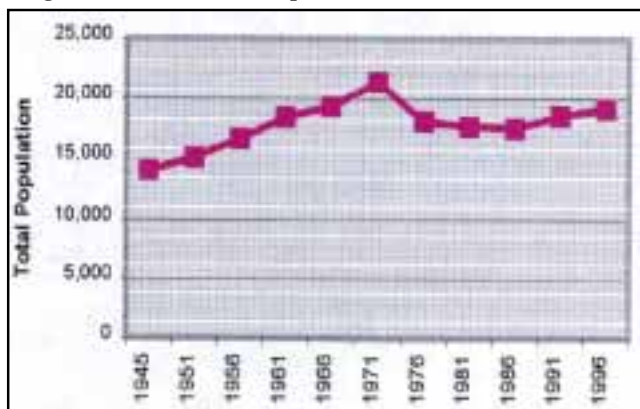
The present social and environmental situation in the Cook Islands has been shaped by the high proportion of expatriate residents compared to other Pacific island countries relative to the local population and the tourist-based economy of Rarotonga. It masks the subsistence lifestyle of most of the outer islands population.

The people are Polynesian Cook Islands Maori and share with the indigenous people of French Polynesia and New Zealand a bond of history and culture. They are acutely aware of their cultural heritage and traditional customs and practices pervade their daily lifestyle. Even though society has been much influenced and altered by external religious beliefs, life-styles and the cash economy, and their adoption of aspects of western culture, traditional culture remains a major influence. While a number of cultural changes have taken place and will continue to do so, the oral traditions of the people, many of the customs surrounding the main phases of life – birth, marriage and death – and the social institutions of the marae (meeting place), koutu (investiture sites) and the paepae (house sites), still persist although some more strongly than others.

There is a strong sentiment within the Cook Islands to strengthen the traditional acculturation of the younger generation to reduce the risk of any further decline in the traditional culture. A central element will be the focus on Cook Islands Maori as the national language; this is particularly important because of the close linkage between language, material culture and environmental appreciation.

Cook Islanders are able to freely live and work in New Zealand, due to the political status of self-government in free association with NZ, which grants Cook Islanders New Zealand citizenship. Therefore, the high natural population increase is offset by emigration. The population has been subject to change with economic cycles as people leave in search of employment opportunities when the economy is in a downturn, whilst numbers rise in times of strong economic growth. Figure 2.4 shows the population of the Cook Islands since 1945. The overall trend is one of increase, although this was offset by a large decrease following the peak in 1971 when economic circumstances resulted in a large net migration. The long-term rate of growth since 1971 has been slower than in the years prior to 1971.

Figure 2.4: Cook Islands Population 1945 to 1996

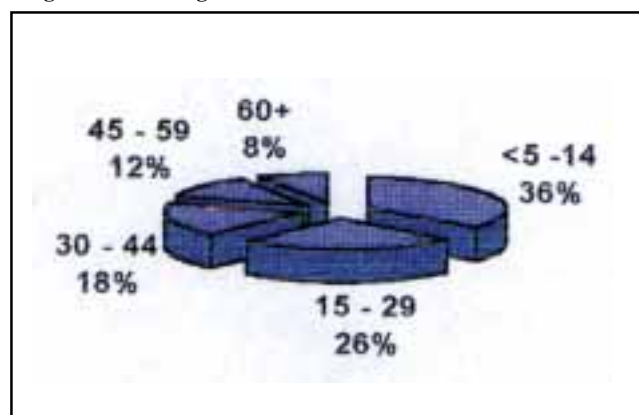


Source: 1996 Census of Population and Dwellings, Cook Islands Statistics Office

Internal migration is an important feature of the demography of the Cook Islands and is consistent with either an increase or decrease in economic activity on the islands. 1991 figures showed for example a population increase of Manihiki of more than 30 percent while the population of Mangaia and Palmerston declined by more than 20 percent. This may be attributed to the increase in pearl farming on Manihiki and the lack of economic activity on Mangaia.

The age distribution is also affected by internal migration and emigration with an ageing population on some of the Outer Islands and of the country as a whole. Figure 2.5 Age Distribution highlights the largest sector of the population is between the age of 0 and 14. This percentage is much larger in the Outer Islands reflecting a very high dependency ratio especially in the Outer Islands.

Figure 2.5 1996 Age Distribution



Cook Islands population trends and patterns are not directly affected by climatic variation with the exception of hurricane Martin in 1997, which resulted in the evacuation of the majority of the population from Manihiki to Rarotonga. Economic and social factors are particularly important motives for population movements.

The 1996 Population Census shows the following distribution of the country's population

Rarotonga	11,153 (59%)
Other Southern Islands	5,294 (28%)
Northern Islands	2,457 (13%)
TOTAL POPULATION	18,904

Current indications are that population distribution, which is consistent with economic development, will continue with a drift to Rarotonga to either reside or stopover in transit for an overseas destination. For those in the outer islands wanting to improve their status, Rarotonga is a natural attraction for employment opportunities. This move to Rarotonga may be further hastened if the sea level rise phenomenon becomes more critical.

2.10. WELFARE

There are no visible signs of poverty or destitution in the Cook Islands. Communities in Rarotonga are better off than those in the outer islands. The population of each is scattered amongst several smaller villages and communities. In each community there is a mix of income groups, and there is a strong tradition of mutual support amongst extended families.

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Settlement on the main island Rarotonga is concentrated on the coastal zone whilst in the other Southern group islands people are concentrated in two or three main villages, some inland and others on the coast. On the atolls of the Northern Group two or three villages are located on the large islets with frequent movement by motor boats between these large islets and small uninhabited motus.

There is no welfare benefit for the unemployed in the Cook Islands. Benefit payments are restricted to children up to the age of 10, old age pensioners, the destitute and the infirm.

Broad social indicators place the Cook Islands towards the top in the Pacific in literacy rates and school enrolment ratios. Life expectancy, infant mortality rates and access to safe water and sanitation compare well with Pacific neighbours. Nevertheless, there is significant disparity in access to and the quality of social service provision between Rarotonga and the outer islands. Widely dispersed populations, remoteness and limited communications with some outer islands present constraints for equal access and efficient nation wide delivery of service.

The government is committed to the provision of equitable cost effective services and this has been enhanced through a UNDP project which will assist the Ministry of Outer Islands Development support the devolution of responsibility in the provision and delivery of these services by the Island Councils.

2.11. EDUCATION AND TRAINING

The Cook Islands have a history of education that dates back to the early missionary days. John Williams introduced Western schooling after his arrival in 1823, under the auspices of the London Missionary Society. Missionary teachers from Tahiti taught pupils in Maori with the emphasis placed on religious and practical skills. In 1840 the Missionary



Society established a teachers' training institution in Avarua and by 1860 universal primary schooling was available to the Cook Islands (Coxon, 1991).

The Ministry of Education of the Cook Islands is responsible for the administration and implementation of education, in accordance with the 1987 Education Act. There are now 28 primary schools in the Cook Islands, 10 of which are situated on Rarotonga. Of those 28, 23 are government schools, while the remainder are privately run, with all but one of these run by churches. There are 23 schools offering secondary level education in total, with three located on Rarotonga. A form three scholarship scheme allows selected pupils from the northern group to travel to Tereora College in Rarotonga. Tereora College remains the national college of the Cook Islands and the only one to offer classes up to seventh form level.

The education system since 1965 has been based on the New Zealand model and generally seeks to achieve similar objectives. Primary education follows a national syllabus and is compulsory for those aged between the age of five and fifteen. Since 1979 it has been government policy to provide a free and secular education system, and as a result the Cook Islands has a high level of literacy.

Post secondary education facilities, however, are limited in the Cook Islands, with what limited services there are being based on Rarotonga only. University of the South Pacific (USP) extension center is located in Avarua, Rarotonga. This offers extension courses at the degree and diploma level, as well as vocational and community level education programmes. There is also a teachers training college in Rarotonga, which provides training for teachers at primary level. Other students wishing to take up tertiary education traditionally travel abroad to do so. Scholarships (through bilateral aid programmes from New Zealand, Australia, World Health Organisation and the Asian Development Bank) are awarded to students to attend institutions in Fiji, New Zealand, and Australia.

2.12. THE ECONOMY

The country's economic characteristics are similar to other Pacific island nations: a large EEZ, limited natural resources, remoteness from major trade and industry centres, absence of economies of scale and skilled manpower shortages.

Until recently the economy has been dependent on government-generated economic activity and employment. The recent economic reform has seen considerable socio-economic change as well as a shift to a smaller more efficient public service. The Government is committed to reducing the burden on taxpayers and to providing more resources for productive investment. Government's broad strategy is to facilitate private sector-led economic growth providing opportunities for private sector investment and management of strategic assets³.

Cook Islanders have traditionally relied on natural resources to sustain a subsistence lifestyle and to provide marketable surpluses. They continue to do so now, especially on the outer islands. Increasingly, through tourism, they now also rely on the islands' natural beauty. But a sustained productive base has not developed in all sectors; as experienced by the fluctuations of agricultural production and the under-exploitation of fisheries resources.

Tourism plays a major part in the economy, estimated at around 37 percent of GDP⁴. Agriculture and fishing, finance and business services (mainly onshore and offshore banking) are also important economic sectors representing approximately 20 percent and 10 percent of gross

³ Cook Islands Government Half Year Economic & Fiscal Update F98/99

⁴ Standard and Poor's, April 1998

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domestic product (GDP) respectively. Government forecasts real growth in these sectors over the next three years.

GDP in real terms has fallen each year since 1996. However, Government considers the economy to have stabilised and forecasts a recovery in real GDP of 2.9 percent for this financial year 1999/00. Real GDP growth for the following two years is expected to exceed 3 percent per annum.

Table 2.3 Economic indicators for the Cook Islands

	1996 ¹	1997	1998
Social Indicators			
Population ²	19,103	18,300	17,400
Visitor Arrivals	48,354	49,866	48,629
Economic Indicators (NZ\$ 000's)			
GDP (1990 prices)	125,352	121,863	117,200
GDP (current prices)	149,069	144,239	139,732
GDP (per capita) ³	7,887	8,290	8,317
Real GDP (% change)	-0.20%	-2.80%	-3.80%
Exports	4,581	4,270	6,011
Imports	69,952	72,332	70,716
Current Balance	-58,371	-68,062	-64,705
Gross Tourism Earnings	13,547	13,905	13,656
Government Finance (NZ\$ 000's)			
	1996/97	1997/98	1998/99 ⁴
Government Revenue	45,900	42,400	43,000
Government Expenditure	42,900	44,200	43,000
Net Operating Surplus (Deficit)	3,000	(1,800)	0
Foreign Debt	47,000 ⁵	116,200 ⁶	116,600 ⁶
Domestic Debt	6,900	6,800	5,000
Total Borrowing	54,100	123,000	121,600

Notes:

¹ All social indicators for 1996, refer to Census data

² Total population

³ GDP in current prices by midyear estimated resident population

⁴ Government estimate

⁵ NZ\$50 million

⁶ Latest estimate of Ministry of Finance & Economic Management, June 1999

Sources

Ministry of Finance & Economic Management, Cook Islands
 Census of Population and Dwellings 1996

2.13. TOURISM SECTOR



The tourism industry has increased at an enormous rate in the Cook Islands and is now the nation's greatest income earner. The number of visitors to the Cook Islands has increased fivefold since 1975 from 10,000 per year to around 50,000 per year in 1998. This represents an average growth rate of about 7 percent per annum. However, the number of visitors has not shown consistent steady growth in the nineties. The number of visitors peaked in 1994, at approximately 55,000 and has since stabilised at less than 50,000. All, but the very few visitors who arrive by sea, enter at the international airport in Rarotonga. Visitors to Aitutaki, the second most populated and developed island, are estimated at 8,800⁵ plus an additional 3,400 day trippers. Government forecasts a recovery and growth in tourist arrivals to 2002 of about 6 percent per annum.

The natural and human resources of the Cook Islands are the basic assets upon which tourism depends for its very existence. It is therefore in the direct economic interests of the tourism sector to lobby as forcefully as possible for conservation and sustainable development of the natural environment. The importance of tourism to the future economy will continue to grow providing the special attraction of the Cook Islands, which draws the tourists in the first place, is not destroyed. Such appeal derives from a blend of people, scenery, and nature tourism opportunity.

2.14. AGRICULTURE SECTOR

Agriculture is a fundamental sector of the Cook Islands. The very concept of "growing your own food" is an inherent part of the culture and heritage of the country and a matter of pride to Cook Islanders as well as providing a means for commercial and subsistence living in the Cook Islands.

Since 1970 the agriculture sector has experienced tremendous changes. Currently commercial agriculture production is less than 2000 tonnes representing less than 20% of export earnings⁶. Although agriculture has been on the decline it remains a key element of the Government economic growth strategy working hand in hand with the growth of the tourism industry. Agriculture is seen as providing the essential fresh supplies to hotel and restaurant owners thus retaining tourist expenditure in the country. Subsistence agriculture is fostered so that it will continue to contribute to improved diets and health of the population generally.

The decline in the agricultural production over the last 10 years has placed substantial reliance on imports for the main basic food items.

Due to the limited land area and the remoteness of the Cook Islands, agriculture faces disadvantages, in comparison to other developing coun-

⁵ Source: Air Rarotonga, May 1999

⁶ Agriculture Annual Report 1997

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tries of the region, especially in terms of transportation, marketing and economies of scale. The agricultural sector is characterised by a traditional land system which can restrict full land utilisation; a high level of part-time activity in agricultural production; limited and expensive inter-island and international shipping and air transport services; limited labour supply; restricted availability of long term credit and a high level of government subsidy for agriculture.

Commercial agriculture continues to suffer the effects of drought. Rainfall in 1997 was 32% below the 1971 – 97 average. For the first three-quarters of 1998, rainfall was 10% below that in the corresponding period in 1997. Pawpaw volumes and export sales in 1997 were lower as a result of the reduced rainfall⁷.

Though the Cook Islands is heavily dependent on imported food, the country does not suffer from food insecurity due to its high per capita income and access to New Zealand. In addition, almost all Cook Islanders have access to some land, the lagoons and ocean where they have always grown and caught their own subsistence food. Due to abundance of fish and good soil, there have never been any major difficulties with availability of food in the country. However, natural calamities, such as drought and cyclones occasionally disrupt food production. There is adequate food security, if viewed in terms of access to nutritionally adequate and safe food for all at all times. The problem facing the Cook Islands is excessive consumption of high-energy food and alcohol⁷.



A large proportion of the population are farmers but only one percent of the farming households derive all their income from agriculture.

Development changes in production systems, economic and technological changes have altered land use practices. Urbanisation and movement of people to the main island Rarotonga has placed pressure on arable land to be used for non-agricultural purposes such as housing and tourism development. Lack of land in the main centres as well as a shortage of employment opportunities has reduced agricultural production and therefore threatens food security on Rarotonga.

The main crop production systems are mixed cropping among subsistence and semi-subsistence farmers who produce crops for household consumption with a surplus available for sale. Commercial farmers who produce mainly for local sale and export are likely to use small-scale mono cropping. The main vegetable crops include tomatoes, cabbages, lettuces, watermelons, pumpkins, courgettes, capsicums, beans, Chinese cabbage and eggplants as well as traditional crops such as taro, tarua (xanthosoma), cassava and sweet potatoes.

The majority of households in the Cook Islands keep livestock (mainly pigs and poultry) for both home use and sale. The estimated total pig population exceeds 20,000, around 90 percent of which are on Rarotonga and the other Southern Group islands. Commercial pig production is small

and meets most of the domestic protein needs of Cook Islanders. There are 19 commercial piggeries having more than 50 pigs.

Agricultural production for local consumption is not able to be reported due to the lack of reliable statistical data available. A mechanism for the collection and collating of agricultural data is yet to be developed.

2.14.1. Land Use Change

Land is the single most important factor that relies on the population and the community to make the right decisions. Land determination and procedures in the Cook Islands are a combination of custom and judicial proceedings.

Southern Islands

Most islands in the southern group are volcanic in origin. The soil has better physical and chemical characteristics with a greater variation in agro-climate. Potential for agriculture is greater due to these characteristics. Changes in land use have seen a vast majority of land being used for construction of housing and tourist accommodation. This has followed with changes such as increased population and lifestyle and the greater economic significance of the tourist industry.

On the islands of Rarotonga and Aitutaki, buildings occupy much of the arable and fertile agricultural land. These changes mean that land will be used more frequently with much reduction in fallow period thereby causing depletion in soil fertility and increases in pest and disease incidences. Agricultural activities will shift to marginal and sloping lands resulting in increased inputs of chemical and or organic pesticides and fertilisers, as well as increased erosion.

The change in climate and land use has caused changes in agricultural practices such as; introduction of new plant varieties to better suit the climate and soil type; increased production of crops under soil-less (hydroponic) conditions; and the increased use of efficient irrigation methods for crop production due to greater demand for water from the public for household needs.

Northern Islands

These seven atoll islands are of small size and remote with limited agricultural potential thus limiting agricultural activities on these islands. Agriculture is further hampered with the lack of soil on these islands. The foreseeable change of the landscape is that of clearing bush giving way to house lots. Significant in the northern group is traditional claims and customary rights to land and lagoon. This is of growing importance now that the cultivation of pearls is becoming an important and lucrative industry.

2.15. MARINE RESOURCES SECTOR

Marine Resources is one of Cook Islands major exploitable natural resources. Cook Islanders have always relied on the sea as a major source of food and it continues to be important to the Cook Islands economy. The production and farming of black pearls and pearlshell from Manihiki and Penrhyn in the Northern Group is the second most important economic sector after tourism. The value of pearl exports for 1998 is up 65% on the corresponding period in 1997. The value of production is set to increase substantially over the next 10 years. Sales from the two main lagoons currently in production are forecast to increase from \$NZ5 million in 1998 to \$NZ6.3 million in 1999, \$NZ10.4 million in 2000 and \$NZ18.3 million in 2001.

⁷ Ministry of Health Annual Report 1996/97

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There has been only limited harvest of fish resources within the Cook Islands EEZ. There are a number of bilateral fishing agreements and the licences for foreign fishing vessels have made a useful contribution to foreign exchange earnings.



Locally based fishing effort remains small scale. One or more commercial scale locally based longline ventures may be established in the near future.

The exploitation of coastal marine resources is increasing, due in part to population pressure. This is evident in the lagoons and coastal areas where a traditional conservation method (Ra'ui) to prevent exploitation has been enforced since February 1998 on the main island of Rarotonga. The establishment of the Ra'ui has been one response to this growing pressure on coastal marine resources and is expected to be extended to the Outer Islands.

Other commercial lagoon fisheries include trochus and giant clams in Aitutaki lagoons.

2.16. OTHER PRODUCTIVE SECTORS

While the public sector continues to dominate the economy the private sector is increasingly important to economic growth. This growth, centred in Rarotonga, has been spurred by the expansion of tourism. The main private sector activities include construction, wholesale and retail trade, restaurants and hotels, transport, and finance and business services. These activities contribute about 40 percent of GDP.

2.16.1. Development Investment Board

Government has established the Development Investment Board (DIB) as a one-stop-shop quasi government agency chartered to facilitate economic growth in the Cook Islands. Its responsibilities include:

- Promotion, facilitation and registration of foreign direct investment;
- Promotion and facilitation of trade into and out of the Cook Islands;
- Assist and increase the participation of Cook Islanders in private sector activities;
- Provide business training and advice to the private sector (in collaboration with the Small Business Enterprise Center).

The Development Investment Board strives to promote the Cook Islands as a good place to do business, as well as a producer of quality export commodities. This outreach program is achieved through a comprehensive marketing and promotional program which includes: advertis-

ing, trade and investment missions, client seminars, proactive client response center from the head office in Rarotonga.

2.16.2. Off Shore Banking

A major contributor to the economy is the offshore financial services industry. There are five trust companies in the Cook Islands, which specialise in the formation and administration of offshore corporations and asset protection trusts for a global clientele. According to a recent industry publication,⁸ the United States Internal Revenue Service has estimated that 14% of offshore trusts established by United States residents, are established in the Cook Islands, (second only to The Bahamas which is estimated at 18%). In the 1998/99 fiscal year, the industry made a direct contribution to the revenues of the Cook Islands Government by way of registration fees, taxes etc., of approximately USD4m⁹. Approximately 70 people are employed directly by the industry.

2.17. TRANSPORT

The islands have 379 km of roads. Rarotonga has the most developed network with 86 km of sealed road and 35 km unsealed. Outer island roads are unsealed, usually surfaced by crushed coral. It is estimated that there are over 2000 vehicles (about 80 percent on Rarotonga) but only 820 were registered in 1994.

The main marine transport facilities are harbours on Rarotonga (which has two, Avatiu and Avarua) and Aitutaki in the Southern Group and Penrhyn in the Northern Group. Avatiu harbour has a container facility and available berths for visiting yachts. The deep water port at Penrhyn is frequently used by large fishing boats and naval vessels. Loading and unloading cargo for other islands is by lighter.

Rarotonga International Airport was built in 1975. Aitutaki has two serviceable runways built during World War II. Penrhyn and Manihiki in the North have small airstrips as well as coral strips on the other islands of the Southern Group. International transport is provided primarily by Air New Zealand and local air transport is provided by Air Rarotonga. The airlines' international and domestic flight schedules are largely dictated by tourist demand.

2.18. ECONOMIC ACTIVITIES IN THE OUTER ISLANDS

The Outer Islands hold the greatest potential for development and investment – however, location, remoteness, and basic infrastructure play important determining factors for potential investors. Viable and operating industries vary by island and they currently include:

MAIRE (Hawaiian maile – foliage garland) – is presently harvested and processed from the Islands of Mauke and Mangaia. The garlands are exported to Honolulu once a week to meet soaring demand. The industry is worth some NZ\$230,000 per year.

NONI (Morinda Citrifolia) – is presently harvested from the Southern Group Islands (80% supply) and also Rarotonga (20%). Raw fruit is picked and exported to Rarotonga for further processing and packaging for export to USA, Australia and New Zealand. This export commodity is estimated to produce NZ\$30,000 per month (or NZ\$400,000 per year) in direct payments – plus associated benefits.

⁸ Offshore Finance USA, Sept/Oct. 1999 Ed., p66

⁹ Figures supplied by the Trustee Companies Association

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HANDICRAFT – handicraft (hats, mats, tapa, wood carvings, crochet) is produced on a number of islands and exported to Rarotonga for the tourist trade and export. This industry is sustained by small groups of women who share common interests. The value of the industry is not known however requests from potential buyers suggest a growing market for Cook Island handicrafts. Rito a natural fibre which is extracted from the very young frond of the coconut tree, is a speciality of the Northern Group Islands (Penrhyn, Manihiki, and Rakahanga) where it is produced in sizeable quantities, for weaving into hats, mats and special gifts. Final products are shipped to Rarotonga for the tourist trade or exported to key overseas markets.

ROOT CROP EXPORTS – Aitutaki has developed its export program with taro and tapioca being shipped to Auckland-New Zealand for sale to Aitutaki nationals. Demand for the product remains stable with supply meeting current demand.

COFFEE – Atiu Island produces and markets approximately 5.5 tons of coffee per annum of which approximately 85% of product is sold domestically and 15% through export channels. The industry is estimated to be worth some NZ\$250,000-NZ\$300,000.

2.18.1. Future Prospects for the Outer Islands

CORAL AND CLAM AQUACULTURE – a new project involving aquaculture farming of live coral and clam for a growing aquarium trade is soon to kick off on selected islands in the northern and southern groups. All products will be exported to key markets overseas.

AQUARIUM FISH – harvesting selected species of small fish for the growing aquarium trade will soon be started in the outer islands. A sustainable harvesting program has been agreed to with the Ministry of Marine Resources.

BECHE DE MER – a project financed and to be operated by the private sector is under discussion. The project proposes to set-up a harvesting program and processing factory on an outer island. All products will be exported to the USA and Asia.

TUNA FISHERIES – a joint venture specialising in tuna fisheries is set to commence business in November 1999. The venture will specialise in fish product (fresh-chilled, frozen loins, and other product lines) for export to Hawaii, USA and Europe.

2.19. ENERGY

The Cook Islands is heavily dependent on imported petroleum products. Only a small percentage of the country's requirements is met from local resources, mainly biomass for cooking and few solar photovoltaic installations mainly in the remote atolls. The country imports three main ground products diesel, mogas and kerosene. Diesel is mainly consumed in the electricity industry while mogas has been used mainly in the road transport sector. Kerosene is for home consumption.

The Cook Islands relies heavily on diesel powered generators for the production of electricity since other sources are limited or not available. The Government is committed to the provision of electricity to every home in the Cook Islands. Today about 98% of the homes in the Cook Islands have electricity.

Since the 1970's, the demand for energy in the Cook Islands which as increased substantially each year has continued to be met mostly from imported petroleum products. This reflects the growth of the commercial



Solar energy use in Pukapuka

sector, most notably in the transport and tourism industry, and the changing way of life of the Cook Island households. The indigenous energy potential of the Cook Islands includes solar, biomass, wind and ocean-based energy sources, all currently underutilized.

The island of Pukapuka in the northern group has photovoltaic system which provides 95 percent of the island power needs. This includes street lighting and household requirements.

2.20. WATER RESOURCES

The main source of water for the Cook Islands is from streams, roof catchment systems, bore holes and community water tanks,

Rarotonga water is captured in the high mountain streams and is gravity-fed into the main distribution network.

Groundwater resources have been identified on Rarotonga but current use is limited although potentially important in the future. Greater numbers of water users on Rarotonga have placed pressure on the water system and in periods of drought some villages have experienced either frequent water shortages or no water. This further justifies the need to tap ground water for emergency use.

Demand

Daily water demand on Rarotonga is currently 10,645m³, which includes a 30 percent leakage or abuse. The watershed catchments can produce 64,000m³ per day.

The water used for consumption is currently untreated – with no added chemicals such as chlorine or fluoride. Water is filtered through the use of fine aggregate and woven filter cloth (primary treatment), and a small percentage of households have installed water filters at the entry to the household.

Water use can be broken down into four main categories¹⁰:

Domestic users per day	3,625m ³
Agricultural use per day	3,692m ³
Commercial users per day	1,118m ³
Tourism per day	2,210m ³

Lack of qualified staff in the Northern Group has meant less data is available to quantify water resources in this region. . Water comes from

¹⁰ Assumptions based on the 1996 Cook Islands Population Census

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rain-fed roof catchments, community tank storage and private household storage as well as freshwater lens. Salt-water inundation into the fresh water lens as a result of sea level rise is a major threat to northern group islands water supply.

Coral reef resources and lagoons provide a very important food source for Cook islanders particularly in the northern group and also on islands of the southern group.

2.21. TERRESTRIAL AND MARINE BIODIVERSITY

The Cook Islands has a relatively limited biodiversity, being well to the east in the general decline of biodiversity as one moves eastward across the Pacific.

Flowering plant biodiversity is also limited, with about 180 indigenous on Rarotonga. In addition to the eastward reduction in biodiversity, the biodiversity declines with decreasing habitat complexity. For example Rarotonga has 180 indigenous flowering plants, the makatea islands have 90 to 100 indigenes, Aitutaki has 40, and the northern atolls vary from 25 in Pukapuka to 18 on Manihiki.

All the islands in the Cook Islands have a coastal community, which has been heavily disturbed by construction and introduced plants since the arrival of the Europeans in the 1820's. Sometimes within the coralline coastal community there are swamplands, which with mulching are useful to grow taro or puraka. This is the limit of the communities found on the atolls and coral islands.

Despite the depauperate flora, the plants of the Cook Islands are widely used by the people. The Natural Heritage Project has documented over 1007 flowering plants of which 163 are used for food, 73 for medicines, 52 have some use in agriculture or horticulture, 20 provide timber, 406 are ornamental (leaves or flowers).

Table 2.4: List of Endemic Species Rare and Significant Species

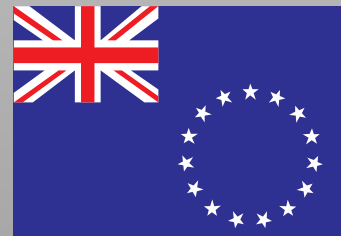
- Rarotonga Fly Catcher
- Starling
- Fruit Dove
- Pacific Fruit Bat
- Mangaia Kingfisher
- Cook Islands Reed Warbler
- Pacific Fruit Bat
- Atiu Swiftlet
- Prichardia Palm
- Mitiaro Fern
- Blue Lorikeet
- Mitiaro Sandalwood
- Green Turtle
- Hawkesbill Turtle
- Coconut Crab



The Cook Islands has 20 indigenous resident seabirds and 13 indigenous resident landbirds, six Alaskan shorebirds regularly spend the southern winter in the Cook Islands. Two of the uninhabited islands, Takutea in the Southern Group and Suvarrow in the Northern Group, play an important part as bird sanctuaries, both supporting species not found elsewhere in the Cook Islands.

2.21.1. Marine

The marine environment can be conveniently divided into the reef system including lagoons, reef flats and outer reef-slope, and the open ocean or pelagic system. Twenty-four coral genera and 58 species have been identified in the Cook Islands mainly on Aitutaki and Rarotonga. Four genera reach their latitudinal limit and do not occur further south.



Chapter 3

NATIONAL INVENTORY OF GREENHOUSE GASES



NATIONAL INVENTORY OF GREENHOUSE GASES

NATIONAL INVENTORY OF GREENHOUSE GASES

3.1. INTRODUCTION

The Cook Islands signed the United Nations Framework Convention on Climate Change (UNFCCC) on 12 June 1992 and ratified it on April 20 1993. In accordance with Article 4.1 (a) of UNFCCC, all parties to the convention are requested to update and report periodically on their national inventory of anthropogenic emissions and removals of greenhouse gases. Funds from the GEF Climate Change Enabling Activity through the Pacific islands Climate Change Assistance Programme (PIC-CAP) were received to undertake the National Greenhouse Gas (GHG) Inventory in 1998.

This is the first greenhouse inventory undertaken for the Cook Islands and it is anticipated that this report will set a foundation and baseline for greenhouse gas emissions in the Cook Islands which is of global concern and requires urgent attention generally.

Greenhouse gas emissions and removals by sinks have been calculated for the year 1994 to ensure that the emission inventory is consistent and comparable across sectors and between Parties.

3.2. GREENHOUSE GASES

Cook Islands is not a primary producer of fuel but it is heavily dependent on imported fossil fuel to meet its growing energy requirements. Thus the main source of fuel combustion in the country is from secondary fuels and these are used mainly in transport and electricity generation. These two sources of GHG emissions dominate the activity data as described in the following sections.

The focus of the GHG inventory for the Cook Islands is:

- Carbon Dioxide (CO₂)
- Methane (CH₄)
- Nitrous oxide (N₂O)

Table 3.1 – Cook Islands Initial National Greenhouse Gas Inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol

Greenhouse Gas Source and Sink Categories	Emissions	CO ₂		CH ₄	N ₂ O
			Removals		
Total (Net) National Emission (Gigagram per year)	32.564			0.504	0.1198
1. All Energy	32.564		Nil	X	X
<i>Fuel Combustion</i>					
Energy and Transformation Industries	16.339		Nil		x
Industry					
Transport	16.052		Nil		
Commercial-Institutional	X				
Residential	00.233		Nil		
Other	X			X	
Biomass Burned for Energy				X	
<i>Fugitive Fuel Emission</i>					
Oil and Natural Gas Systems				X	
Coal Mining				X	
2. Industrial Processes	X				x
3. Agriculture				0.4916	x
<i>Enteric Fermentation</i>			Nil	0.4916	
<i>Rice Cultivation</i>				X	
<i>Savanna Burning</i>				X	
<i>Others</i>				X	x
4. Land Use Change and Forestry			154.438		
<i>Changes in Forest and other woody biomass stock</i>			154.438		
<i>Forest and Grassland Conversion</i>	X				
<i>Abandonment of Managed Lands</i>	X				
5. Other Sources as appropriate and to the extent possible					
Waste				0.0128	0.1198
Solid			Nil	0.0128	
Liquid			Nil		0.1198

Note 1: x - Data to be presented to the extent the Party's capacities permit (Article 12.1(a)).

Note 2: Non-Annex I national communications will include the information in this table, and a description of assumptions and methods used, and the values of emission coefficients, where these differ from IPCC assumptions, methods and values.

Note 3: Efforts should be made to report the estimated range of uncertainty, where appropriate.

NATIONAL INVENTORY OF GREENHOUSE GASES

Calculations have been based on source categories of energy, agriculture, land use change and forestry and waste. However, the sources from each category were not fully applied because of either apparent lack of data or insufficient data available at the time of the inventory work.

3.3. METHODOLOGY AND DATA

The emissions estimated and presented in this statement were calculated according to the 1996 IPCC Revised Guidelines for National Inventory of Greenhouse Gases, to ensure that the emission inventory is consistent and comparable across sectors and between Parties.

The IPCC guidelines have been followed and all default values provided have been used. It is noted however that this approach has been modified to account for the fact that the IPCC Guidelines does not fully capture issues of scale for small island developing states and the unique characteristics of the Cook Islands.

A top-down or a reference approach has been used for the preparation of this national inventory of greenhouse gases.

3.3.1. Sources of data

The data used to complete the Cook Islands Greenhouse Gas Inventory for the base year 1994 were obtained as provided in Table 3.2 below.

Data for a particular item were obtained from two or more sources. Verification of statistical data with users was an important aspect of validating data collected.

Discussions were held among concerned parties including the PICCAP Country Team as well as a workshop, which involved the major sectors to ensure the most reliable information, was obtained.

Table 3.2 Sources of Data¹

Source of Data	Type of Data Collected
Ministry of Finance and Economic Management, Statistics Division	Statistical data and Imports
Ministry of Marine Resources and Fisheries	Total fish caught for local consumption
Petroleum Companies, Mobil, Triad, Juh	Confirm petroleum imports
Ministry of Works Energy and Physical Planning, Energy division	Outer Islands power generation
Tu'anga Taporoporo, Environment services	Solid Waste estimates
Shipping Company, Taio Shipping	Local shipping fuel consumption
Ministry of Agriculture	Land use, forestry, livestock
Te Aponga Uira O Tumutevarovaro	Rarotonga power generation

3.4. ORGANISATION

The National Inventory has been organized into four parts which corresponds to the four major source categories as described in the IPCC 1996 Guidelines. No emission estimates were made from industrial processes and solvents due to lack of activity data and that no methodology now exists for solvents and other product use.

- **Energy**
Power generation
Transport
- **Memo items**
International bunkers
- **Agriculture**
Enteric fermentation
Manure management
- **Land Use Change and Forestry**
Managed Forests
- **Waste**
Solid Waste on land
Liquid Waste

Uncertainty and limitations of emission estimates

The uncertainties and limitations, as per IPCC guidelines are reflected throughout this chapter.

3.5. EMISSIONS

Carbon dioxide emissions for the Cook Islands were mainly from liquid fossil fuels and petroleum. Total imports of fuels for 1994 was 29.59676 kilo tonnes. Table 3.3 illustrates CO₂ emissions from each of the major fuel types within the major sectors.

Table 3.3: Sectoral CO₂ (Gg) Emissions based on Fuel Types

Fuel Type	Kilo tonnes	Power Generation	Transport	Domestic	Totals
Gasoline	3.20608		9.81789		9.81789
Jet Kerosene	10.38881		1.95650		1.95650
Other Kerosene	0.06011			0.15510	0.15510
Gas/Diesel Oil	6.73579	16.07572	4.08326		20.15898
Residual Fuel Oil	0.04688	0.10802			0.10802
LPG	0.01816			0.01744	0.01744
Bitumen	0.00026		0.00037		0.00037
Lubricants	0.14067	0.09500	0.19433	0.06085	0.35018
TOTAL	20.59676	16.27874	16.05235	0.23339	32.56448

The total amount of GHG emissions for the energy sector was:

- **32.564 Gg from CO₂ representing 98 percent of total GHG emissions**

Carbon dioxide emissions from fossil fuel represent 99.9% of total GHG emissions.

¹ Compiled by Tom Wichman and Kori Raumea

² Numbers rounded to five decimal points

NATIONAL INVENTORY OF GREENHOUSE GASES



3.5.1. Power Generation

The Cook Islands relies heavily on diesel powered generators for the production of electricity since other sources are limited or not available. The resulting emission from this activity totalled

- **16.278 Gg of CO₂ representing 50 percent of total CO₂ emissions.**

Table 3.4 illustrates energy consumption in the Cook Islands. Since the 1970's, the demand for energy in the Cook Islands has continued to be met mostly from imported petroleum products which has increased substantially each year. This reflects the growth of the commercial sector, most notably in the transport and tourism industry, and the changing way of life of the Cook Island households.

Other islands including Palmerston, Suvarrow and Nassau refers to unaccounted petroleum consumption for outer islands where records are poorly maintained.

Only two islands receive 24-hour electricity service – Aitutaki and Rarotonga.

The islands of Pukapuka, Suvarrow and Nassau do not have centrally operated national grid power diesel-generated for the island.

Carbon dioxide emissions as well as noise are major problems with diesel generated power systems on the islands. In addition petroleum spills are evident on the coastal areas where diesel is stored prior to delivery of fuel to the generator site. Appropriate disposal sites and management of waste oil is of significant concern to communities on the Outer Islands.

Table 3.4: Energy Consumption in the Cook Islands

Island	kwh/ltr	Energy Generated kwh'000	Total Fuel Consumption 1994 ³		Gg CO ₂
			Litres	Kilo tonnes	
Rarotonga	3.8	3628	95467	3.71	11.75600
Aitutaki	2.7	1512	56000	0.48	1.48876
Mitiaro	1.9	79	41374	0.03	0.05901
Mangaia	2.5	334	13361	0.11	0.31319
Atiu	2.5	238	95319	0.08	0.21787
Mauke	2.0	196	97879	0.08	0.21787
Penrhyn	2.0	90	44962	0.03	0.05901
Rakahanga	2.0	33	16559	0.01	0.01967
Manihiki	2.5	78	31172	0.02	0.03934
Other islands					2.10802
TOTAL		6188	492093	4.55	16.27874



3.5.2. Transport

Road transport is a major activity in the Cook Islands. Type of transport activity for 1994 is illustrated in Table 3.5 below:

Table 3.5: Total Transport Types (1994)

Types of Transport	Total Number
Motor Bikes	529
Motor Vehicles	108
Trucks	54
Vans/Pickups	119
Other Vehicles	10
Total	820

Source: Cook Islands Savings Bank (CISB) Rarotonga

Table 3.5 above highlights the number of vehicles that are officially registered however the emission is calculated on the total gasoline consumed. This suggests that there are a large number of unregistered vehicles.

Table 3.6: Carbon Dioxide emissions (Gg) for Transport Sector

Domestic Aviation	Kilo tonnes	Gg CO ₂
Gasoline	0.00599	0.01825
Jet Kerosene	1.05030	3.28190
Road Transport		
Gasoline	3.20600	9.75560
Gas/Diesel Oil	0.98680	2.99660
Total	5.24909	16.05235

³ Cook Islands Quarterly Statistical Bulletin December Quarter 1998

NATIONAL INVENTORY OF GREENHOUSE GASES

Table 3.6 identifies the fuel consumption in the transport sector as 5,249 kilo tonnes of petroleum fuel in 1994. This produced:

- 16.05235 Gg of CO₂ representing 50 percent of total CO₂ emissions from domestic aviation and road transport.

3.5.3. Domestic

Domestic consumption of petroleum is very small for the Cook Islands.

- It represents only 0.07 kilo tonnes of fuel which produced 0.17254 CO₂ (Gg) of emissions.

The major fuel use for domestic consumers is from kerosene and LPG.



The Cook Islands main methane emission comes from agriculture. It is concerned only with enteric fermentation and manure management. This is from animal waste and decaying plant materials.

Livestock mainly pigs and poultry are raised by the majority of households in the Cook Islands, for both home use and sale. It is estimated that the total pig population exceeds 20,000, around 90 percent of which are on Rarotonga and the other Southern Group islands. Commercial pig production is small and meets most of the domestic protein needs of Cook Islanders. The 1996 Population Census identifies 19 commercial piggeries having more than 50 pigs which is the largest producer of methane emissions.

The Cook Islands has low levels of methane compared to other Pacific Island countries due to limited land mass for agricultural purposes, and small numbers of animals. Methane emission is summarized in Table 3.8 below:

Table 3.8: Methane Emissions from Livestock

Livestock Type	Population (000's)	Enteric Fermentation	Manure Management	CH ₄ Emission
Non Dairy Cattle	0.3550	18.815	002.485	0.0213
Goats	5.6990	28.495	001.253	0.0297
Horses	0.1980	03.564	000.431	0.0039
Swine	20.745	20.745	414.900	0.4356
Poultry	40.045	-	0.92100	0.0009
Total		71.619	419.990	0.4914

Methane emissions from domestic livestock through enteric fermentation and manure management is 0.4914Gg which represents .015 percent of total GHG emissions.

3.7.1. Land Use Change and Forestry

A wide variety of carbon and nitrogen trace gases are either emitted or absorbed in the biosphere. Any changes in the biosphere, through land use changes and forestry activities will modify the natural balance of these trace gases both in emission and uptake. On the global scale the human activity which most affects the biosphere is deforestation in tropical regions.

In this sector the calculation of emission for the Cook Islands focused only on managed forests.

3.6. MEMO ITEMS



3.6.1. International bunkers

International bunkering accounted for 30.72Gg of CO₂ emission in 1994 from international marine and international aviation bunkers as illustrated in Table 3.7

Table 3.7 International Bunkering

	Consumption (kilo tonnes)	Gg CO ₂
International Marine		
Gas/Diesel Oil	0.37951	1.1937
International Aviation		
Jet Gas/Diesel	9.75440	30.7261
Total	10.13391	31.9198

International bunkering has been calculated but has not been included in the national totals and is reported for informational purposes only. It indicates that international bunkering of petroleum products for marine and aviation contributes to as much carbon dioxide emissions as the total energy sector.

3.7. AGRICULTURE

Although agriculture has been on the decline it remains a key element of the Government economic growth strategy working hand in hand with the growth of the tourism industry. Agriculture is seen as providing the essential fresh supplies to hotel and restaurant owners thus retaining tourist expenditure in the country. Subsistence agriculture is fostered so that it will continue to contribute to improved diets and health of the population generally.

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3.7.2. Managed Forests

The main source of nitrous oxide is from agriculture sector from the burning rather than decaying of agricultural materials. Again, the Cook Island levels of emission for this gas are very low compared to other Pacific Island countries due to the small-scale forests in the Cook Islands. The Cook Islands has small land areas in forest and therefore there is no major deforestation except owing to dry spells and forest areas become fire hazards. Mangaia island of the southern group during 1996 lost a large area of forest through accidental burning during a hot dry spell.

A managed forest program for the Cook Islands commenced in 1987 with the primary objective of minimizing soil erosion mainly on the Southern Group islands of Atiu, Mangaia and Rarotonga. The plantation forest today covers 11000 (2700 acres). Approximately 95% of these are planted in *Pinus caribaea*.

As well as soil protection forests are critical components of the climate system. There is potential for sequestering greenhouse gases and they act as an additional reservoir for CO₂.

In the national inventory assessment survey for Cook Islands the CO₂ uptake from changes in forests and other woody biomass stocks was analyzed and the results are presented in the Table 3.9 below.

Table 3.9 Carbon Uptake by Forests

Forests	Area (kha)	Annual Growth	Annual Biomass Increment	Carbon Fraction of Dry Matter	Total Carbon Uptake Increment
Acacia	0.699	15	10.4850	0.5	5.2425
Eucalyptus spp	0.00585	14.5	0.0848	0.5	0.0424
Tectona grandis	0.00585	8	0.04680	0.5	0.0234
Pinus spp	0.03495	11.5	0.04019	0.5	0.2009
Pinus caribaea	1.13	10	11.3000	0.5	5.6500
Mixed Hardwoods	4.66	6.8	31.6880	0.5	15.844
Mixed Softwoods	2.085	14.5	30.2325	0.5	15.1162
Total					42.1194

- Total Carbon Uptake Increment 42.1194
- The Annual biomass carbon removal is 154.4382

3.8. WASTE

Methane is one of the principal sources of greenhouse gases contributing to global warming. Methane emissions originate from several sources including anaerobic decomposition of organic wastes in solid waste disposal sites, in sludge and residual solid by products. In this sector, methane emission is calculated from solid waste disposal sites and liquid waste generated.

3.8.1. Solid Waste

Solid waste in the Cook Islands is managed through informal waste minimisation practises. This includes diversion of food waste as animal feed, burning of paper and green waste and disposal of residual in ground pits. Rarotonga is the only island in the Cook Islands that has a centrally managed landfill for solid waste. All outer island communities and households are forced to dispose waste in vacant land areas or private pits.

The consequences of this are serious. Exposed wastes present immediate public health risk, degradation to the surrounding environment and increased uncontrolled methane emissions.

Total emissions from municipal solid waste is calculated on total municipal waste generated being

- 3.666 Gg producing 0.012804 Gg of methane.

3.8.2. Methane

Methane emissions produced from

- Domestic livestock enteric fermentation and manure management 0.4916
- Plus Solid Waste 0.0128
- **Total CH₄ (Gg) emissions 0.5044**

3.8.3. Liquid Waste

Sewerage waste for most of the islands is by septic tanks and cesspits. Most are poorly built, or are not well maintained. A private company collects septage sludge and is dumped on orchards and open ground. There is no septage treatment facilities on any of the islands except for one small treatment and public sewer system on the island of Rarotonga in the village of Nikao. Established in this area are a large number of Government houses. This system has not been operated successfully due to poor maintenance and lack of funds.

Nutrient and organic loading from liquid waste presents a significant problem to all coastal regions where the inner reef lagoon is well-developed and extensive. This includes the island of Rarotonga where the coastal areas are densely populated with tourist resorts but also on the northern group islands of Manihiki where pearl farming requires unpolluted lagoons. Poor management of liquid waste means that these lagoons offer the ideal environment for unwanted microbiological activity.

Liquid waste produces nitrous oxide emissions from humans and animals. This is calculated as follows:

Indirect nitrous oxide emission from human sewage using a population base of 19,303 produces

- total annual N₂O emissions (Gg) of 0.11834.
- Nitrous oxide from animal production emissions from animal waste management systems is only
- total annual emissions of N₂O (Gg) of 0.001479.
- Total N₂O emissions for the Cook Islands is 0.1198 represents less than one percent of total GHG emissions.

3.9. CONCLUSION

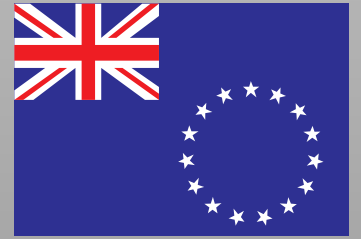
Although a reduction of our emissions will not be noticeable to the average person, noticeable savings could be made on the importation of fossil fuels by government if the decision is made to encourage renewable energy programmes and improve the efficiency of all diesel generators. These savings could be used for education and health..

NATIONAL INVENTORY OF GREENHOUSE GASES

Emission of carbon dioxide represents the largest contributor of GHG emissions for the Cook Islands, which comes mainly from power generation. Identified mitigation options for the Cook Islands are identified in Table 3.10.

Table 3.10 Mitigation options

Sector	Weakness	Solution
Energy	Poor or lack of maintenance of diesel generators Variable load on diesel generators Prevent importation of incandescent light bulbs Prevent importation of high energy consuming appliances Reduce energy use	Replace worn out diesel generators Controlled loading of generators to no less than 70 percent Replace with fluorescent bulbs Import licensing and policy developed Encourage solar heating and other renewable energy options
Transport	Poor road maintenance Speeding on roads Warrant of Fitness Tests inadequate	Improve road construction Enforce maximum speed limits Implement and improve standards required for Vehicle Warrant of Fitness



Chapter 4

VULNERABILITY AND ADAPTATION

VULNERABILITY AND ADAPTATION

VULNERABILITY AND ADAPTATION

4.1. INTRODUCTION

The foundation for this chapter is the result of consultation and information provided by all the major sectors¹ in the Cook Islands and the Cook Islands PICCAP programme. It represents the current state of knowledge with respect to climate change and sea-level rise, and is the first of its kind for the Cook Islands. It builds on the capacity building provided through PICCAP for a large number of people from various sectors, and is the beginning of an on-going process of further capacity building and vulnerability work that is currently being undertaken by Cook Islanders. As a small island country, which is not a significant greenhouse gas producer, such work is vital to the future of the Cook Islands given that it will have little option but to adapt to changes in climate change and sea level rise.

The vulnerability and adaptation chapter is founded on the Intergovernmental Panel on Climate Change (IPCC) technical guidelines. However, this approach has been modified to account for the unique characteristics of the Cook Islands as a small Pacific Island country.

In the Cook Islands the key sectors, which are likely to be affected by climate change and sea level rise, are:

- Coastal zone and coral reefs
- Agriculture, food security and diet
- Marine resources
- Water resources
- Biodiversity

4.2. CLIMATE AND SEA-LEVEL RISE SCENARIOS

The Cook Islands historically has not been subject to extremes of temperature and rainfall, and interannual variations in sea level. It is uncertain as to how these local fluctuations will be affected as a consequence of global changes in climate and sea level arising from the enhanced greenhouse effect. It will be important for the Cook Islands to have access to the best currently available information derived from global models that are as locally relevant as possible. The use of such information, as presented below, must be qualified by the high uncertainties particularly in relation to the direction and magnitude of future rainfall changes, and how the sea level for the Cook Islands will change relative to projected global changes. In the absence of more accurate information it is appropriate to use the best information that is currently available as a basis for assessing the sensitivity of different sectors in the Cook Islands as a whole, to climate and sea-level rise.

4.3. TEMPERATURE AND RAINFALL SCENARIOS FOR THE COOK ISLANDS

At present scenarios of possible future climate and sea levels in the Cook Islands and the Pacific islands' region are not available. Therefore, scenarios presented below in Table 4.1 are based on the projections developed by the IPCC and were the simulated results from two general circ-

ulation models (GCMs). These scenarios have been used to ask "what if" questions about the effects of climate and sea level change and how sensitive a country is to the changes.

Table 4.1 Temperature and Rainfall Scenarios

GCM pattern	2020		2050		2100	
	Temp. (C)	Rainfall(%)	Temp. (C)	Rainfall(%)	Temp. (C)	Rainfall(%)
HADCM	0.6	5.1	1.2	10.3	2.2	18.9
CSIRO9M	0.4	-0.1	0.8	-0.1	1.5	-0.2

This report considers the IPCC best-guess (middle) and worst (high emissions) case scenarios of projected temperature rise and sea level rise. The table shows the temperature scenarios using two different GCMs, one by HADCM (UK) and CSIRO9M (Australia). While the magnitudes of the various model scenarios differ, it is important to note that they all indicate that there will be an increase in temperature. By the end of the next century the models used here show that temperatures may have increased by between 0.4°C and 2.2°C over those presently experienced.

At present many GCMs are not yet able to reliably indicate how rainfall patterns might change in the region as shown by the two GCM results here. One output shows that wetter conditions will prevail (HADCM), while the other indicates that there may be drier conditions in the future. Preliminary work by some climate scientists has indicated the possibility that rainfall might be characterized by high intensity events on the one hand, and prolonged droughts on the other. Other work indicates that such extremes in the Pacific islands regions may also be dominated by El Nino-Southern Oscillation (ENSO) phenomenon.

It should also be noted that while the projected temperature increases, especially those from the middle range scenario, do not seem particularly large, they would be superimposed on what is already a hot climate. From this perspective, any slight increase in temperature becomes significant.

4.4. SEA-LEVEL RISE SCENARIOS

The only scenarios of sea-level change for the Cook Islands, drawn from the current global projections based on the IPCC Second Assessment Report and are presented in Table 4.2 below, for a best guess and high estimate of greenhouse gas emissions. Both show significant increases in global sea level over the next century. However, one cannot assume that changes in sea level at regional and local levels will necessarily be the same as the global average change because of the influence of relative sea level associated with vertical land movement, which affects sea level. Dynamic effects resulting from oceanic circulation, density, wind and pressure patterns, and ocean currents also influence sea level at the local and regional level.

Table 4.2 Sea level rise scenarios

Scenarios	2020	2050	2100
IS92a (best guess)	8cm	20cm	49cm
IS92e (high)	16cm	40cm	94cm

¹ Ministries of Health, Agriculture, Marine Resources, Environment Service, Water Division and Energy Division of Ministry of Works, Energy and Physical Planning, Meteorological service

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The table provides a broad indication of what might be expected over the next century, based on the middle and worst emissions scenarios of sea-level change. These sea level projections are consistent with the temperature projections, i.e., substantial increases in sea-level are likely over the next century.

4.5. VULNERABILITY

There are various sectors in the Cook Islands that are already sensitive to climatic factors and sea level variations. These sectors with their selected exposure units were considered based upon pertinent criteria and information available in relation to their overall significance to the well-being of the people and the economy of the Cook Islands. These sectors are:

4.5.1. Coastal Zone and Coral Reefs



The coastal zone provides a wealth of beauty and is an essential element in the development of tourism for the Cook Islands as well as the base for sustaining livelihoods and economic development for Cook Islanders. The coral zone supports abundant fish populations and shellfish, which are very important in the diet of Cook Islanders. It provides protection of the shoreline from erosion, traps sediment for land accretion, and provides a breeding ground and habitat for marine species. The sensitivity of the coastal zone to the effects of climate and sea level variations is dependent on coral reefs and saltwater *paspalum* ecosystems. The shoreline of all the islands of the Cook Islands is very dynamic, and thus places high cost infrastructures on such things as tourist accommodation, roads and private dwellings that are concentrated and built along the coastal edges at risk.

Widespread concern has been expressed over the state of the coral reef systems and monitoring of these reefs has indicated signs where large areas of reef are damaged and are no longer sustaining life.

Coastal erosion is already evident in many areas of the main island Rarotonga. This can be directly linked to a decline in health of the reef system as well as activities such as removal of coastal vegetation, the blasting of reef channels and poorly constructed sea walls. There is some evidence to indicate that other Southern and Northern Group islands are experiencing similar impacts. Many of these problems have arisen because of the lack of an effective environmental impact assessment (EIA) process as well as a fully integrated environmental management programme.

Lack of an effective water drainage system is also contributing to erosion of land from surface water runoff, as was evidenced by the heavy rains experienced in the Southern Group islands mid 1999. In some areas of the coastal plain there are low lying areas behind the beach ridge which are prone to flooding from storm surge. In addition, there are areas of intensive infrastructure development with poor water drainage systems

that are prone to flooding during rainstorms. These factors, in combination, make coastlines of Rarotonga and other islands increasingly sensitive to variations in sea level, and to storm events.

4.5.2. Agriculture, Food Security and Diet

Agriculture is a key component of the food production system and provides a means for commercial and subsistence living in the Cook Islands. Variations in rainfall patterns can have a great effect on the yield and sustainability of crops grown in the Cook Islands.

Commercial agriculture continues to suffer the effects of drought. Rainfall in 1997 was 32% below the 1971 – 97 average. For the first three quarters of 1998, rainfall was 10% below that in the corresponding period in 1997. Pawpaw volumes and export sales in 1997 were lower as a result of the reduced rainfall².

Cook Islanders have a relatively high per capita income and therefore the country does not suffer from food insecurity. In addition, almost all Cook Islanders have access to some land and the lagoons and ocean where they have always grown and caught their own subsistence food. Natural calamities, such as drought and cyclones occasionally disrupt food production.

A large proportion of the population are farmers but only one percent of the farming households derive all their income from agriculture. Variations in rainfall patterns can have a great effect on the yield and the life of agricultural crops and in particular the main export crops of the Cook Islands, pawpaw and taro. Other important crops that are sensitive to climate and sea-level rise are vegetable crops for local consumption as well as the growing flora industry.

Reduction in agricultural land as a result of sea-water intrusion, inundation, and flooding and coastal erosion, which can be triggered by sea level variations, already creates major problems to agricultural activities particularly in the coastal region and reducing the already limited land available in the Northern atolls.

4.5.3. Marine Resources

Pearl shell farming is a high priority in the economic development of the Cook Islands with export values expected to double in 1999³. Other commercially important coastal resources such as trochus shell and ornamental fish are also important and techniques are needed to identify the extent of their vulnerability to climatic variation.

4.5.4. Water Resources

Domestic water is sourced from stream catchment and roof catchment systems, bore holes and community water tanks, and therefore the Cook Islands remains highly dependent on rainfall. This means the Cook Islands are highly vulnerable to changing weather patterns and times of drought. During El Nino periods the Southern Cook Islands often experience lower rainfall levels, while higher rainfall is experienced in the northern atolls. During La Nina, however, the North becomes more susceptible to dry periods, with rainfall becoming more plentiful in the Southern islands.

Periods of heavy rainfall too can cause problems to the water supply. Heavy downpours often cause flooding in the inland streams, which causes debris to be washed downstream, and disturbs sediment at the bottom of the streams. During such periods of heavy rainfall it is not uncommon

² Cook Island Government Half Year Economic and Fiscal Update F98/99 December 1998

³ Cook Island Government Half Year Economic and Fiscal Update F98/99 December 1998

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for households to find that their water turns a ‘muddy brown’ colour and incidences of gastric illnesses become more common, as the quality of water is compromised.

4.5.5. Biodiversity

Terrestrial



Brown Booby (*Sua Leucogaster*)

Storm surge is damaging to ground-nesting seabirds on low islands – especially the Brown Booby, Masked Booby, Red-tailed Tropicbird, Blue-grey Noddy and the Black-naped Tern.

Storm surge also damages coastal plants, some of which are rare, such as the Romanzoff Shrub on a few atolls, and Polapuka on Pukapuka

High winds damage inland Rarotonga by spreading wind-dispersed weeds, such as the Balloon Vine and by opening the forest floor to increased sunlight which enables weedy species in general to outgrow native species.

High winds can directly damage forests such as happened to the only atoll forest in the Cook Islands, on Pukapuka.

Increased summer droughts on Rarotonga have a dramatic effect on stream life as the fresh water fishes need to reach the sea to breed and have no mechanisms to “hibernate” during drought periods.

Suwarow atoll in the Northern Group and Takutea island in the Southern group have two of the most vulnerable bird colonies in the Cook Islands⁴. No comprehensive study exists to assess the potential impact of climate change on the ecology of bird colonies. Climatic variability including a greater incidence of tropical weather extremes, such as drought and tropical cyclones, could decimate sea bird populations.

Marine



⁴ McCormack and Kunzle 1990

⁵ Implications of Climate Change and Sea Level Rise for the Cook Islands, Graham Sem and Yvonne Underhill, 1991

Increased water temperature means that the ocean will more often exceed the critical 20°C associated with coral bleaching. These events have been more frequent in recent years and are expected to increase. Some corals are more susceptible than others and this will lead to not only a decrease in coral biodiversity but to a changing composition of coral communities.

Wave damage will also physically remove corals from the upper section of the outer reef slope.

The removal and death of corals leaves more “bare areas”. This can lead to an increase in macro-algae, which in turn can support more ciguatera dinoflagellate. This may result in an increased incidence of fish poisoning.

Increased rain over high islands leads to increased volcanic silt being washed onto the reef system which is detrimental to coral growth. This also leads to increased nutrients on the reef system and if this occurs over the summer spawning time it can alter the recruitment rate of organisms.

4.6. EFFECTS

Due to the lack of quantitative data, the limited scientific capabilities, and the limited studies or absence of previous literature and information, the understanding of the effects of climate change and sea level change in the islands is limited. Therefore, qualitative statements are made in this report from a very limited resource.

4.6.1. Coastal Zone

The potential impact of climate change on coastlines in the Cook Islands is likely to be more dramatic than the consequent sea-level rise. This is because much of the coastline consists of unconsolidated and permeable beach rock, which can be easily eroded either by high-energy storm surge or by lateral erosion caused by heavy rainfall on high islands. Sea level rise will also affect shorelines through inundation. A study⁵ showed that 17 percent of Rarotonga is below 1.5 meters and if the sea level was to rise by 1.5 meters much of this land area would be inundated.

4.6.2. Coral Reefs

Coral reefs in the Cook Islands presently survive near the limits of their temperature tolerance of 25C to 29C. Any increase in sea surface temperature may result in coral bleaching and loss of coral species, reef habitat and reef building processes. In the absence of the adverse effects of temperature change, sea level rise may lead to renewed coral growth on the reef flat which is presently exposed at low tide.

Local people have already observed a decrease in the vitality of the reef systems and considered that this may be a climate-related effect. While this may indeed be the case, it is likely to be linked to the decline in reef health as a result of over-fishing, uncontrolled pollution and destructive effects of economic development and some fishing methods. As loss of reef vitality decreases the ability of the reef system to cope with other environmental stresses, such as ongoing exploitation, destructive practices will worsen any adverse effects of climate change.

4.6.3. Coastal Erosion and Flooding

The coastline in the Cook Islands has become increasingly prone to erosion through damage to the reef flat, stream mouths and coral species,

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removal of coastal vegetation and intensive development of infrastructure and housing. Given this situation, any relative increase in sea level in the Cook Islands will result in a worsening of the erosion problems. Increased sea level rise, even with no change in storm frequency, would increase the potential for wave overtopping and flooding of the low lying areas of the coastal plain. Additionally, a scenario of increased rainfall, particularly if it resulted in more intense or more frequent rainfall events, will add to the erosion and flooding problems related to surface runoff.

Further development and continuation of existing trends in the coastal zone could accelerate the problems of erosion associated with sea level rise, lead to loss of land area and place an increasing amount of infrastructure and people at risk.

4.6.4. Agriculture

Cook Islands agriculture, by its nature, is relatively vulnerable to changes in normal weather situations, wet or dry seasons including unusual weather patterns over time as a result of global warming.

Effects of climate change that will impact directly on agriculture include:

- Low-lying Northern group atolls as a result of sea level rise will experience coastal erosion, sea spray and salt-water inundation into the underground freshwater lens, impeding crop growth. This will further reduce the amount of land available on these small islands for agricultural production. Cyclones and dry periods will have major impact on these islands as they cannot shelter from wind and wave surge as experienced by cyclone Martin in 1997 and long dry periods will reduce water supplies to critical levels. Lack of rain will further reduce any agricultural production.
- Higher volcanic Southern islands as a result of sea level rise will experience salt-water inundation in groundwater freshwater lens and the infrastructure surrounding the coastal areas of the islands will be at risk. Excessive rainfall will cause soil erosion and reduce the amount of productive agricultural land. This will reduce any exports and will further require the importation of fresh vegetables to meet the demands of the tourist industry.

General warming of the climate may contribute to the emergence of new pests and diseases not previously found in the country. Prolonged drought periods as well as reducing productivity will raise the likelihood of fires as experienced by Mangaia in 1995. This destroyed protective vegetation and agricultural crops thus increasing the incidence of soil erosion which, in turn, reduced land productivity.

4.6.5. Marine resources

The marine resources sector is one of the nation's major exploitable natural resources. Cook Islanders have relied on the sea as a major source of food. The Ministry of Marine Resources perceives marine life such as fish, crustacea and molluscs to be threatened by the long-term effects of climate change, its impact on ocean circulation and sea level rise. As sea surface temperatures already frequently exceed the temperature tolerance level of coral species (25C – 29C), it is likely that any significant increase in sea surface temperature in the future will result in more frequent and severe episodes of coral bleaching.

It is also expected that should average sea surface temperatures continue to change in the future, further changes in the concentration and avail-



ability of fish stocks will likewise occur. Reduced stocks of some species are a real possibility, with the obvious consequences for Cook Islanders who rely on marine resources for their livelihood. The recent ENSO event saw a major shift in offshore fish distribution patterns as tuna fish stocks migrated according to oceanographic surface temperature and salinity fronts. Further global warming and circulation of the ocean would have a major affect on the distribution of the tuna fishery resource of the Cook Islands 200-mile EEZ.

The pearl culture industry is the second most important economic sector and is dependent on good environmental conditions. Elevated water temperature conditions are conducive for disease outbreak as well as causing oyster recruitment to exceed lagoon carrying capacity. Cyclone Martin in 1997 caused damage to 95 percent of farmers' land based infrastructure and to 15 percent of the cultured pearl shell. Aquarium fish, a new industry in the Cook Islands, and trochus, are susceptible to direct destruction from cyclone events.

4.6.6. Human Health

The scenario of continued environmental and social degradation, combined with the climate change would lead to a continuation and possible worsening of the existing health problems in the Cook Islands. In particular those conditions related to scarce water resources, overcrowding and poor environmental sanitation and hygiene would be likely to increase. In addition marine resources which have always been vital to the health and wellbeing of the people of Cook Islands may become increasingly less productive both as a direct and indirect consequence of climate and sea-level change.

Climatic conditions influence the life cycles of some insects such as mosquitoes. Wet conditions are ideal for rapid multiplication of the mosquito population, hence its longevity. This further contributes to the multiplication of parasite carrier mosquitoes as well as mosquito biting rates. Thus overall, temperature variations strongly influence epidemic potential. Extreme events such as cyclones and flooding have several direct effects on public health including loss of life, injury and outbreaks of water borne diseases. Conversely, deterioration in water quality and quantity as a result of dry conditions in the future may result in an increase in diarrheal diseases.

Anecdotal evidence has shown increases in water borne diseases or ailments in periods of wet weather and increases in vector borne diseases in dry periods.

It seems likely that climate change would have a negative, if hard to measure, effect on the health of Cook Islanders. Direct health impacts are likely to include an increase in heat stress and in respiratory, allergic

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and communicable diseases. High temperatures are likely to place additional stress on the population and may increase mortality rates. Vector borne diseases, like dengue spread by mosquito (*Aedes Aegypti*) are more likely to spread in high temperatures coinciding with heavy rain-falls.

Indirect health effects would result from droughts, floods and social and economic disruption. These would place a burden on Government to deliver improved health and sanitation services. Flooding would result in poorer water quality leading to increase in diarrhoeal incidence as well as growing malnutrition as a result of home grown food shortages. Low income families, children, and the elderly would be most at risk from the negative effects of climate change.

4.6.7. Water Supply and Quality

Changes in climate have been known to affect both water quantity and quality particularly in areas prone to weather variations. Extreme weather conditions have different impacts. Very dry conditions of 1982/83 led to water rationing and the country's green vegetation clearly showing brown colour due to critical water stress. Likewise, heavy downpours have led to flooding of low-lying areas. In either case, water quality is affected; the water reticulation system tends to carry mud and debris under both conditions.

Thus, significant falls in average rainfall or increase in drought frequency or length would adversely affect water supply and quality. Likewise, a heavy downpour will affect water supply, with blockages occurring and quality diminished.

Sea level rise will also impact on fresh water resource in terms of salt-water inundation into the fresh water lenses of the low-lying atoll islands limiting land for agriculture.

4.6.8. Biodiversity

The major threats to biodiversity for the Cook Islands are habitat changes, degradation and loss. Although no intensive studies have been done for the Cook Islands on this issue, informal reports from various non-government organisations, especially women's groups, have expressed concern over the decline of certain natural resources required for subsistence and handicraft production. An example of this is the 'pupu' shell which women collect to sell, and are becoming difficult to find. It has been suggested that this may be due to habitat change caused by either fresh or salt-water inundation or long periods of drought, as experienced in Mangaia recently.

Any change in temperature may result in the change of species' composition as well as the functioning of ecosystems will change in response to changing climatic conditions.

Increasingly, climate change has begun to shape the nature of the islands' biodiversity, especially though episodic events such as cyclones, for example cyclone Martin in Manihiki, which destroyed much of the flora on the low lying atoll in 1998.

4.7. ADAPTATION MEASURES

For the Cook Islands to respond successfully and implement appropriate adaptation strategies each major sector has identified information gaps and capacity building requirements that must be addressed.

4.7.1. Marine Resources

Information Gaps

- Knowledge of circulation processes within lagoons and the influence of climate. This would assist in understanding oceanographic processes relevant to:
 - Pearl and mariculture production
 - Shallowing lagoons
 - Lagoon flushing
 - Lagoon temperature change
- Knowledge of the interactions between marine flora and fauna (including coral), and the effects of external influences on these species and their interactions. These effects could include local species extinctions, changes in species dominance, species resilience (tolerance) to disturbance, species introductions and species substitutions.
 - Increase knowledge of pelagic fisheries migration and recruitment patterns in our EEZ.
 - Develop gene bank of marine flora/fauna.
 - Model low diversity marine ecosystems.
 - Understanding of ecosystem rejuvenation after implementation of traditional conservation management practices e.g. Ra'ui.
 - Identify specific integrated effects affecting marine resources – e.g. coastal sedimentation from rainfall runoff through Avatiu Harbour.

Specific Capacity Building Needs

- Increase physical oceanography expertise regionally.
- Deal with issues at the ecosystem level rather than single species.
- Increased environmental ocean modeling of tuna and other pelagic stocks.
- Training and equipment required
- Increase biological species database

4.7.2. Coastal Zone

Information Gaps

- Knowledge of the change in beach profiles and the causal factors
- Understanding of the effects of coastal developments and structures
- The effect of sea level rise on the coastal foreshore – natural and developed
- Measures to develop and enforce legislation relating to the coastal zone
- Methods of development and implementation of integrated management plans
- Understanding coastal protection options

Specific Capacity Building Needs

- Training and equipment required for surveying, coastal and engineering
- Education and awareness
- Legislation and policy
- Integrated management plans

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4.7.3. Agriculture, Food Security and Diet

Information Gaps

- Understanding of areas most vulnerable to changes in weather patterns
- Understanding causal factors leading to insect and disease outbreaks
- Identification of most suitable plants, crops, varieties and cultivars to climate change
- Additional methods of quarantine to reduce further pests and diseases introduction
- Measures to understand land zoning and building policies
- Gene bank of plants
- Lack of up-to-date information on plant/crop, livestock, and forest production figures

Specific Capacity Building Needs

- Develop geographical information system (GIS)
- Update information on agricultural land use through application of GIS
- Continuous monitoring of insect and disease incidences and severity.
- Gather information from other countries and organisations on performance of plant cultivars/varieties under certain climatic conditions
- Education and awareness
- Gene bank development

4.7.4. Water Resources

Information Gaps

- Identification of leakages
- Water quality and chemical analysis monitoring
- Methods and measures to improve water distribution at all times
- Water consumption data
- Pipeline network data
- Lack of co-ordination between development and water distribution
- Methods to improve water storage and conservation

Specific Capacity Building Needs

- Education and awareness
- Training and equipment
- Geographical information systems development
- Legislation
- Metering and tariffs
- Groundwater management
- Mechanism for water development
- Improvement in water quality

4.7.5. Human Health

Information Gaps

- Unavailability of up-to-date information on the pattern of lifestyle disease, vector borne disease and water borne disease in relation to climate change.
- Limitation of resources to monitor the high density of mosquitoes and possible outbreaks of dengue fever.
- Limited access to modern technology (internet) to enhance skills and knowledge on global impacts of climate change on human health
- Measures to develop and enforce legislation
- Methods of development and implementation of integrated pest management

Specific Capacity Building Needs

- Regular access to workshops, conferences, meetings and internet services
- Education and awareness
- Training and equipment
- Integrated pest management systems
- Legislation

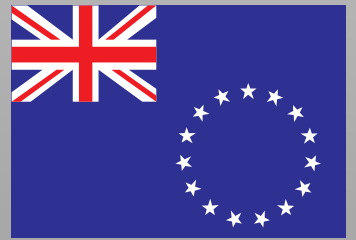
4.7.6. Biodiversity

Information Gaps

- Increase knowledge of bird, flora and fauna habitats
- Strengthen links between science and policy development/formulation
- Develop gene bank of marine flora/fauna.
- Understanding of ecosystem rejuvenation after implementation of traditional conservation management practices
- Identify specific integrated effects affecting birds, flora and fauna
- Increase knowledge of bird, flora and fauna and the effects of external influences on these species and their interactions.
- Continue to develop database of traditional and indigenous uses related to biodiversity

Specific Capacity Building Needs

- Education and awareness
- Gene Bank
- Training – biodiversity data collection and analysis
- Increase biological species database
- Methods for ex-situ collections



Chapter 5

CROSS SECTORAL MEASURES

CROSS SECTORAL MEASURES

CROSS SECTORAL MEASURES

5.1. INTRODUCTION

A number of measures will be undertaken by the Cook Islands, which will have cross cutting implications for all or some of the sectors discussed earlier. These measures will help and support the mitigation and adaptation measures that have already been identified.

Cross-sectoral measures refer to the types of support measures or mechanisms that could be applied nationally. These measures can be developed as individual programmes and will include:

- Policy Measures
- Research Programmes
- Education and Awareness Programmes

Information gaps have been identified as well as capacity building needs to enable full and appropriate implementation.

5.2. POLICY MEASURES

This National Communication is particularly timely, as the Cook Islands is developing a blueprint for its future. The November 1997 National Retreat¹ defined the national vision for the Cook Islands as:

“Te oraanga tu rangatira, kia tau ki te anoano o te iti tangata, e kia tau ki ta tatou peu maori, e te aotini taporoporoia o te basileia.

“To enjoy the highest quality of life consistent with the aspirations of our people, and in harmony with our culture and environment.”

Government has recently reaffirmed this vision and remains committed to fulfilling it².

However the Government recognizes that more work needs to be done to translate the national vision into a set of goals and strategies that are achievable within the resources available, and which will provide a fair and equitable outcome for all.

The work undertaken to produce the national communication and the ongoing work that will arise from it will enhance these goals and strategies as well as improve the process and decisions made regarding the environmental and cultural sustainability of the Cook Islands.

5.2.1. National Goals³

Government believes that not all the aspirations can or should be met by Government. Some aspirations are more appropriately the responsibility of the private sector. In some instances people need to take increasing personal responsibility for their own lives.

Since the start of the economic reform programme (ERP) in 1996 the Government has been committed to creating a smaller more efficient public service. The community's aspirations can be grouped into seven areas. These are:

¹ Meeting of representatives of all sectors of the community (Government, non Government, business sector, community and traditional leaders)

² Cook Islands Government Budget Policy Statement 1999/2000

³ Cook Islands Government Half Year Economic and Fiscal Update F98/99, December 1998

Health

Government places increasing emphasis on preventative health care with the corresponding increasing personal responsibility for curative health care. Emphasis is on prevention rather than cure.

Education

A larger proportion of government resources will be focused on education up to lower secondary level with increasing personal responsibility for higher levels of education.

Justice and Equity

The government aims to ensure a proper balance of responsibility between community, family, individual and the government.

Participation

Government sees its role as one of facilitator. The provision of opportunities for participation is largely the responsibility of the private sector, churches and NGO's.

Culture and the Environment

Government sees its role as one of advocate and to some extent funder but also sees the community and the private sector having a large role to play.

Sustainable economic growth

The private sector of the Cook Islands is seen to be the “engine” of economic growth. Government's role is to provide a good environment for investment in order to facilitate private sector development.

Good governance and effective government

Government is committed to minimising the size of government while “getting more for less”.

5.2.2. Future Outlook

The outlook for the Cook Islands is positive with trends in productive sectors expected to improve over the next five years with tourism promising greater increases. The economy is aiming towards growth where the population will enjoy a better standard of living.

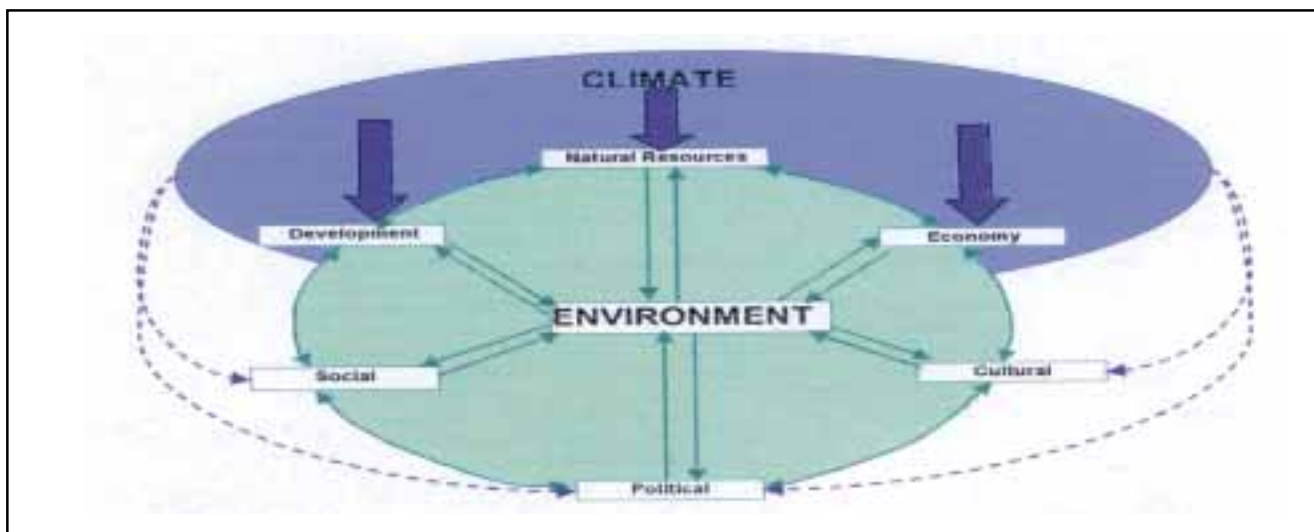
Incorporation and mainstreaming of climate change and sea level rise issues into government policy is ongoing and will take time to fully achieve integration.

5.2.3. Additional measures for government consideration

- Reduction in greenhouse gas emissions
- Training in appropriate statistical data collection
- Land use options
- Waste management systems
- Appropriate technology transfer
- Appropriate manufacturing options
- Renewable energy options
- Environmental education and awareness
- Effective implementation of an environmental legal framework and traditional practices
- Development of a comprehensive integrated coastal zone management plan

CROSS SECTORAL MEASURES

Figure 5.1: Integrated Comprehensive Approach



Adaptation and mitigation strategies for the Cook Islands will be based on an integrated and comprehensive approach, which encompasses the health and well being of the nation. Local communities should be involved at all stages of the development of adaptation programs. The lead sector should be coastal and marine areas and an adaptation plan, to be part of a climate change action plan, should be drafted, implemented, monitored and regularly updated.

Current economic development objectives are based on the national aspiration to increase the per capita income of all Cook Islanders and to share in the productive sectors of the economy. This is a shift from a policy of dependence to one of self-reliance. The current developmental objectives take greater account of the potential of human resources to increase productivity and utilise the private sector as the engine to drive the economy.

Some of the important effects in the Cook Islands and their interactions are identified in Figure 5.1 above. It does not attempt to provide a definitive description of interactions and cumulative effects but it does provide an indication of some of the most important interrelationships.

The most important aspect of Figure 5.1 is that it highlights the very strong inter-linkages between all aspects of human and natural systems that exist in the Cook Islands and that no effect can be considered in complete isolation. The blue semi-circle shadow of Figure 4.1 demonstrates that climate and sea level rise directly impact on the three major sectors, natural resources, development and economy. It will have an indirect impact on political, social and cultural sectors. However the political, social and cultural systems will determine how these potential impacts will be managed.

There is a clear need for better information aimed at providing a more integrated understanding of effects. It is important that integrated assessment methodologies are developed which are appropriate to the unique, and highly integrated, biophysical, social and economic environment of the Cook Islands.

Figure 5.1 above illustrates the integrated nature of all sectors on each other. The sectors are all dependent and interrelated as demonstrated by the circular flow and inter-linking circular arrows. The sectors of the diagram are defined as:

- Environment – all things natural
- Development – man made structures and features

- Social – demographic, health and education
- Economic – business and trade
- Cultural – traditional values
- Natural Resources – all things natural
- Political – governance, legal framework and systems
- Blue shadow – climate and sea level rise

5.2.4. International Environmental Treaties

Since about 1988, the Government of the Cook Islands has signed various treaties in its own right, including the three sister conventions – United Nations Framework Convention on Climate Change (FCCC) and the Kyoto Protocol; the Convention on Biological Diversity (CBD); and the Convention to Combat Desertification (CCD).

In signing the above three conventions, Government has signified the commitment it attaches to the establishment of frameworks to address the issues raised by these Conventions. The Government understands the need to contribute as appropriate towards the achievement of the objectives of these conventions.

The Cook Islands takes its commitment to Climate Change along with these other treaties seriously, especially in light of the fact that the Pacific region as a whole has been affected by adverse climatic conditions including severe drought conditions. The successful implementation of the various conventions is expected to improve living conditions, and reduce poverty, while also helping to alleviate problems such as migration, loss of plant and animal species, climate change and the need for emergency aid to population in crisis.

5.3. RESEARCH PROGRAMMES

There are a number of research programmes that are being undertaken in the Cook Islands.

These have been established in the areas of Meteorological Services, Disaster Management, Agriculture and Marine Resources.

CROSS SECTORAL MEASURES

5.3.1. Meteorological Service Current Systematic and Observational Networks

The Cook Islands Meteorological Unit is working continuously to provide the most recent climate data not only for the national climate database but also to support the work of regional and international organisations like the World Meteorological Organisation (WMO).

There are six automatic weather stations (AWS) located on the islands of Aitutaki, Manihiki, Mangaia, Mauke, Pukapuka and Penrhyn. Synoptic three hourly weather reports are interrogated from a platform on each of these islands through a modem in the main office in Rarotonga.

In addition two upper air stations are situated in Rarotonga and in Penrhyn. While Rarotonga operates two radar flights a day, the Penrhyn station has only one release a day at 1.00pm local time (2300 GMT).

A SEAFRAME station was installed at Avarua Harbour (Rarotonga) to monitor sea level and has been in operation since 1994. Data from this observational network will contribute to the global models that are implemented by the Intergovernmental Panel on Climate Change (IPCC) and other research organisations as well as meeting the needs and demands of the Cook Islands community. These provide the Cook Islands Meteorological Service with the daily weather readings and information for organisations like WMO who are carrying out readings to assess climate patterns globally.

Meteorological Services of the Cook Islands are responsible for collating climate data. They are required to monitor climate change and sea level rise and to implement their programme successfully the following information gaps and specific capacity building needs have been identified:

Information Gaps

- Early storm surge warnings
- Early cyclone warnings
- Lack of data collection
- Identification of mechanisms for cost effective transfer of data

Specific Capacity Building Needs

- Education and awareness
- Training and equipment
- Data transfer systems

5.3.2. Disaster Management

Preparedness and a “no regrets” approach has been implemented in the Cook Islands through the Disaster Management Agency. A national plan for Disaster Preparedness has been developed to enable correct responses to the potential influences of climate change phenomena.

The Cook Islands communities live within a range of natural and man-made hazards, which make the Islands very vulnerable to disasters of varying magnitudes. In the main the natural hazards include those of climatic origin, cyclones, floods, drought, fire, storm surge and man-made hazards including those that arise as a result of human interference. Furthermore, the Cook Islands has encountered a significant increase in the number of tropical cyclones, seasonal around November - April, over the past decade.

One death is attributed to tropical cyclone Peni in 1990 and eight to tropical cyclone Martin in 1997. Social, economic and environmental loss was extensive and severe after each cyclone. Economic loss after cyclone Sally in 1987 was estimated at 66% of Cook Islands GDP and cyclone

Peni losses were considered to be over \$NZ2 million at a time when the Cook Islands was still recovering from Sally.

To enable adaptation options to be implemented the following information gaps and specific capacity building needs have been identified for disaster management.

Information Gaps

- Lack of information on areas vulnerable to flooding
- Lack of Information on drainage systems
- Legislation development

Specific Capacity Building Needs

- Education and awareness
- Training and equipment
- Warning systems
- Appropriate legislation

5.3.3. Agricultural Research

The Ministry of Agriculture continues to work on developing response plans and research towards the predicted climate change in the future.

There is a continual use of good and fertile land for developments other than agriculture, especially on the islands of Rarotonga and Aitutaki. This has prompted the Ministry of Agriculture to continue its investigation into the performance of new high yielding cultivars of vegetables, rootcrops, and fruit trees with better production per unit area under our climatic and soil conditions.

Cultivars of vegetables and rootcrops with increased tolerance of drought and waterlogged conditions and pest and disease resistance are being investigated. Taro (*Colocasia esculenta* Schott.) and Giant Swamp Taro (*Cyrtosperma chamissonii*) that may have some level of tolerance to brackish water will be collected and maintained for the Northern Group Islands.

The collection and maintenance of different varieties of root and tuber crops; exotic fruit trees; and bananas for distribution to the public as well as enhancing crop performances through cross breeding programs must be maintained.



5.3.4. Marine Research

The Ministry of Marine Resources currently has several research arrangements with international organisations. The Flinders University of South Australia and University of Hawaii maintain an array of tide monitoring gauges in the Cook Islands. Coral coring surveys have been conducted for climate change with assistance from the University of Hawaii and TOGA Station University of Edinburgh. SOPAC offers assistance with coastal modelling as well as water resource investigations.

CROSS SECTORAL MEASURES

5.4. EDUCATION AND AWARENESS PROGRAMMES

Special efforts will be made to ensure the public understand and are aware of climate change issues. Awareness will be raised through the use of a wide range of communication tools such as television, radio and practical demonstrations.

The Cook Islands population has little knowledge of climate change, its implications and likely impacts to their daily lives and the nation as a whole. Therefore education and awareness will be very important to ensure that all people are environmentally aware.

5.4.1. Formal Education

Climate change has yet to be included and mainstreamed in the current curricula of the formal education system. For future populations to understand and make intelligent and have informed views on the implications of climate change and sea level rise these topics must be incorporated into the curricula of primary and secondary schools. This can be supplemented with

- School visits and discussion groups
- Media and awareness
- Poster competitions
- Public displays
- Essay competition
- Tree planting activities as sinks
- Speakers to support curricula

5.4.2. Informal Education



Informal education activities will be the most effective method of sharing and creating interest in climate change issues. Audiovisual and media print are the two most important tools to develop and use for public dissemination of information. This should involve:

- Weekly television spots
- Television programmes
- Weekly newspaper articles
- Advertisements on radio, television, print
- Mitigation and adaptation awareness campaign – tips for the consumer
- Public comment on national climate change documents
- Public library information and displays

As part of the ongoing education and awareness programme it will be

essential that partnerships be developed with the government agencies and non-government organisations. Each organisation can share in the dissemination of information that climate change poses a risk to future generations and this risk must be taken seriously.

5.4.3. Media and Climate change: public awareness and media campaigns

The media programmes will be implemented:

- To promote the conservation of water, sound waste management, coping in disaster situations, and sustainable development practices on all islands and to preserve or revive traditional conservation practices which support education on climate change.
- To foster a spirit of consultation and public co-operation through better use of the media so that necessary changes to conserve and protect the environment and human life, particularly during times of disaster, are led by public acceptance.
- To develop curriculum materials in environmental education, including climate change and disaster management, for the national education system and community-based education.
- To train workers in a variety of sectors – media, government, and community groups on effectively informing publics of climate change and related environmental areas.
- To raise awareness of political leaders so that they become effective communicators of climate change and related environmental issues, and to provide the same aims and supplementary materials for climate change and media workers at national level.
- To facilitate production of materials and education aids which would support the above aims.

5.5. CONCLUSION

It is noted that understanding of climate and sea level rise effects, and vulnerability and adaptation in the Cook Islands has been constrained by significant limitations of information and knowledge.

The information provided is a summary based on the work of many people involved in the various sectors of the Cook Islands.

Adaptation in the Cook Islands should be based on an integrated and comprehensive approach, which encompasses the health and well being of the nation. Local communities should be involved at all stages of the development of adaptation programs. The lead sector should be coastal and marine areas and an adaptation plan, to be part of a climate change action plan, should be drafted, implemented, monitored and regularly updated.

A national adaptation strategy in the Cook Islands should follow a 'no-regrets' approach. Such an approach would prioritise the development and implementation of policies and measures which are beneficial for both the environment and the well being of the Cook Islands even in the absence of climate and sea-level change.

It is important that all adaptation options to be adopted must take into account the integrated nature of the environment and the positive approach to redress a negative impact may have further negative impacts in other areas. Stronger measures must be adopted in the management of the environment to reduce the risk of climate change, which will be difficult to predict and therefore manage. All these measures should be integrated into economic planning and implemented through an integrated and comprehensive approach.

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