Country Report for UNCED

Tonga

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FOREWORD

In common with many island nations of the Pacific basin, the Kingdom of Tonga has a limited resource base. With an urbanisation trend, coupled with an emerging manufacturing sector and expanding tourism industry, natural resources continue to diminish, raising fundamental questions about resource allocation and distribution.

In line with its concern for a shrinking resource base, the Government of Tonga is committed to a course of action which will ensure that the Tongan way of life is environmentally sound and sustainable for all generations. Significant steps have already been made in this direction with the recent completion of an environment management report which details the state of the environment and of broad national environment strategies. Together these provide a base for the current preparation of detailed environment management strategies and programmes which will be implemented over the coming decade.

The planned convening, therefore, of a United Nations Conference on Environment and Development (UNCED) in Brazil in June 1992 is most timely, and this National Report has been prepared for UNCED.

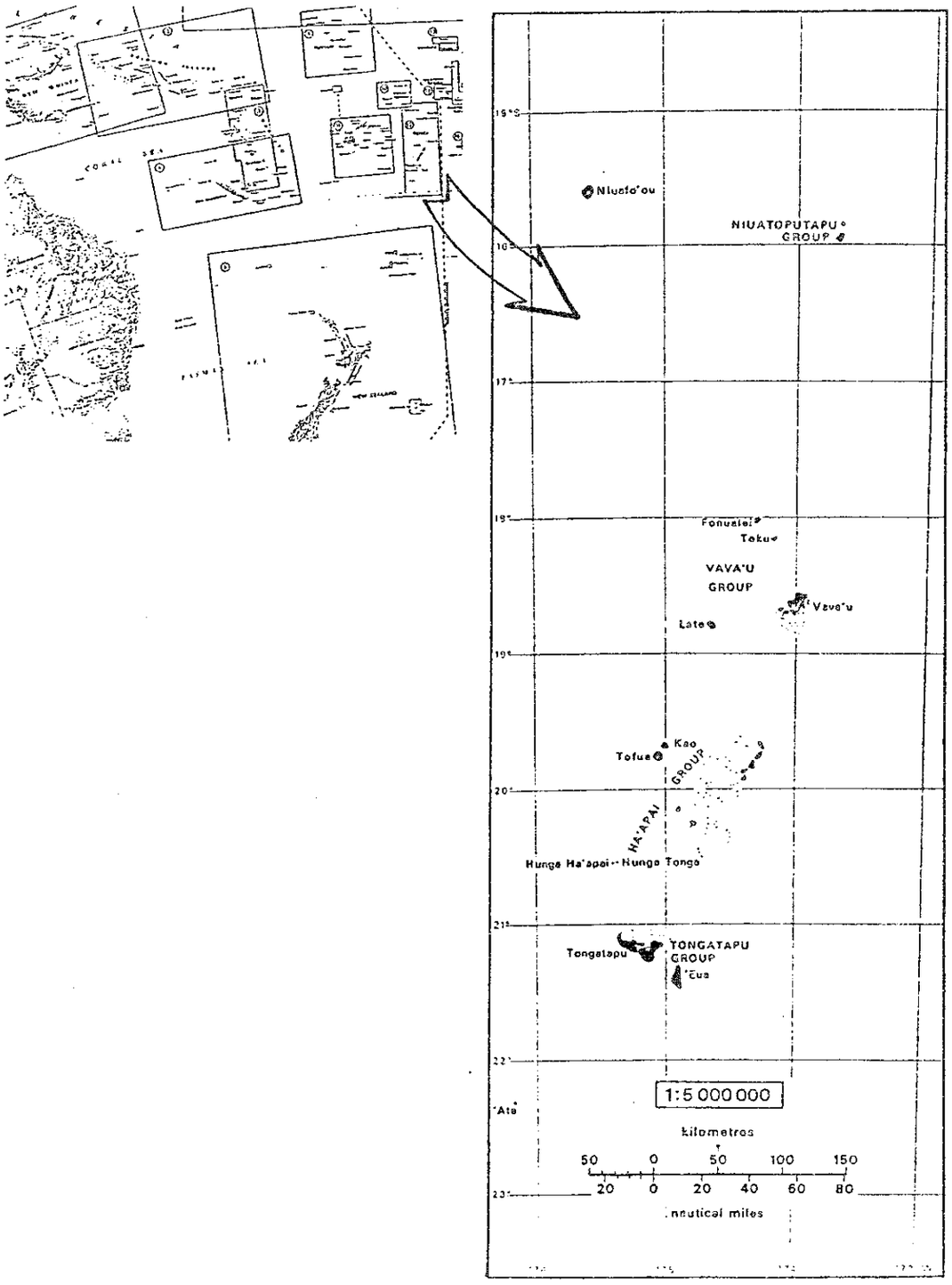
The report briefly examines development trends in the Kingdom and associated environmental impacts, indicates the Government's responses to environmental issues and then explores the opportunities for sustainable development in light of perceived constraints. These opportunities are focussed within four issues of central concern for the Kingdom: population and human settlement; land use planning and management; natural resources and energy conservation; and trade, industry and development investment.

I see the report as one more element in an ongoing process of formulating and implementing policies which will ensure a sustainable pattern of economic development for the Kingdom. I commend its reading to all those who love the Tongan way of life and seek for its continuance in perpetuity.

S. Ma'afu Tupou

The Hon. Dr S. Ma'afu Tupou
Acting Minister -
Ministry of Lands, Survey
and Natural Resources

THE KINGDOM OF TONGA



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ACRONYMS

ADB	Asian Development Bank
AIDAB	Australian International Development Assistance Bureau
ASPEI	Association of South Pacific Environment Institutions
BDDP	British Development Division in the Pacific (UK/ODA)
CIEL	Centre for International Environmental Law
CSIRO	Commonwealth Scientific and Industrial Research Organisation, Australia
CETC	Community Education Training Centre, SPC
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
DP	National Development Plan of the Kingdom of Tonga
DPIII	National Development Plan 1975/76-1979/80
DPIV	National Development Plan 1980/81-1984/85
DPV	National Development Plan 1985/86-1989/90
DPVI	National Development Plan 1990/91-1994/95
DSIR	Department of Scientific and Industrial Research, New Zealand
DTCD	Department of Technical Cooperation & Development, UN
EC	European Community
ECG	Economic and Commercial Group, GOT
EIA	environment impact assessment
EMA	environment monitoring and assessment
EMP	Environment Management Plan
EPOC	ESCAP Pacific Operations Centre, Vanuatu
EPS	Environment Planning Section, MLSNR
ESCAP	Economic and Social Commission for Asia and the Pacific
FAO	Food and Agriculture Organisation, UN
FFA	Forum Fisheries Agency
FPSI	The Foundation for the Peoples of the South Pacific International
GAW	Global Atmosphere Watch
GDP	gross domestic product
GEMS	Global Environment Monitoring System, UNEP
GIS	geographic information system
GLOSS	Global Sealevel Observing System
GNP	gross national product
GOT	Government of the Kingdom of Tonga
GRID	Global Resource Information Database, UNEP/GEMS
ICOD	International Centre for Ocean Development
IDEC	Inter-departmental Environment Committee, GOT
IFREMER	Institut Francais de Recherche pour l'Exploitation de la Mer
IGOSS	Integrated Global Ocean Services System
IMR	Institute of Marine Resources, USP
INR	Institute of Natural Resources, USP
IUCN	International Union for Conservation of Nature and Natural Resources
JICA	Japanese International Co-operation Agency
LATICAL	Laboratoire de Traitement d'Images Caledonien, ORSTOM
MAF	Ministry of Agriculture and Forestry, GOT
MOF	Ministry of Fisheries, GOT
MLSNR	Ministry of Lands, Survey and Natural Resources, GOT
NOAA	National Oceanic and Atmospheric Administration, US
NWFC	National Weather Forecasting Centre (Fiji)
ORSTOM	Institut Francais de Recherche Scientifique pour le Developpement en Cooperation, Noumea
SOPAC	South Pacific Applied Geoscience Commission
SPACHEE	South Pacific Action Committee on the Human Environment and Ecology

SPC	South Pacific Commission, Noumea, New Caledonia
SPF	South Pacific Forum, Suva, Fiji
SPREP	South Pacific Regional Environment Programme, SPC
TCSP	Tourism Council of the South Pacific
TNC	The Nature Conservancy, US
TOGA	Tropical Ocean Global Atmosphere
UFP	Universite Francaise du Pacifique
UG	University of Guam
UH	University of Hawaii
UN	United Nations
UNDP	United Nations Development Programme(W.Samoa, Fiji, Papua New Guinea)
UNEP	United Nations Environment Programme (Nairobi)
UNITAR	United Nations Institute for Training and Research, (Geneva)
UNITECH	University of Technology, Lae, PNG
UPNG	University of Papua New Guinea, Port Moresby
USAID	United States Agency for International Development
USEPA	United States Environmental Protection Agency
USP	University of the South Pacific
WCU	World Conservation Union
WHO	World Health Organisation, UN
WMO	World Meteorological Organisation,UN
WWF	World Wide Fund for Nature
WWW	World Weather Watch

I. EXECUTIVE SUMMARY

The Kingdom of Tonga shares with many South Pacific developing countries a limited natural resource base, except for the potential exploitable resources of the Exclusive Economic Zone, a small domestic market, large distances to markets and high transport costs, limited economies of scale and a traditionally high dependency on a few agricultural products.

The Kingdom differs in some respects from the general pattern of small island economies in the following ways: the country has an emerging manufacturing sector, a high educational level, and a relatively more developed economy.

The development of the Tongan economy is constrained by the low level of domestic financial savings and the difficulty of disecomomies of scale in production. This serves to exacerbate high costs imposed by location and lack of marketable resources.

The development trends and environmental impacts, and the responses made by government to environment/development issues have led to the identification of four main sustainable development issues within which environmental planning and programming should be focussed. These sustainability issues are: population and human settlement planning; land use planning and management; natural resources and energy conservation; and trade, industry and development investment.

At the end of this Executive Summary, a simplified matrix is presented which summarises for these sustainability issues, the significant constraints, and the opportunities perceived for achieving sustainable development in the Kingdom of Tonga.

Environmental programming strategies

These opportunities for sustainable development suggest a programming focus on six strategies:

- Institutional strengthening.
- Protection of biological diversity
- Pollution control
- Urban planning/coastal zone management
- Environmental information and education.
- Environmental legislation.

Institutional strengthening

The Environment Planning Section of the Ministry of Lands, Survey and Natural Resources, as the central environmental agency working with all environmental sectors, should attract funding assistance for at least the next five years while core programs are developed and put in place.

But the core, in-country, environmental management capability within any one environmental sector lies within established mission departments and will continue to do so. This capability should be reinforced rather than attempting to duplicate it within a generalist environmental department.

Assistance to the mission departments is therefore advocated through the appointment in each of a small environment unit, or of an officer with environmental qualifications within existing planning units. The role of

each officer would be to ensure that the development activities of other departments do not have an adverse environmental impact on the resources for which his/her own department has prime responsibility.

The role of the EPS is to maintain the essential linkages with decision-makers within the bureaucracy, to coordinate environmental planning and assessment (in close consultation with the Central Planning Department) and to oversight the adoption and maintenance of sustainable development policies within the individual mission departments.

Budgetary support

The strong support for sustainable development is witnessed in many Parliamentary documents and Government submissions. The Government's necessary budgetary focus on economic development has, however, resulted in many significant conservation issues receiving little budgetary support. The annual budget for conservation activities is currently extremely small, and with most of that expended on staff salaries and wages. Funds available for conservation initiatives are minuscule.

Aid donors thus have the opportunity of playing a significant role through technical assistance to broaden conservation activity.

Biological diversity

Aid donors could focus immediate attention on:

- protection of the remnant biological diversity in the volcanic islands; and national park development in the remaining rainforest area of 'Eua; and the

- acquisition of up-to-date and accurate data on remnant vegetation, wildlife and marine resources. Such surveys lead to database development for marine and terrestrial resources, and the continued upgrading of such databases through programs of routine monitoring. (The regional GRID/GEMS projects coupled with a colour air photography project will help correct this deficiency.)

- the identification of conservation areas of particular value and preparation of a protected area master plan which conserves biological diversity, and critical terrestrial and marine ecosystems.

Pollution control

Particular caution will be exercised in proposing any agricultural or forestry development which could lead to greatly increased use of fertilisers or biocides and the risk of contamination of water and food.

While broadening of the country's economic base through new industrial development is desirable, the selection of clean, noxious-free industries is seen as fundamental to ecologically sustainable development in the longer term. And the provision of any loan or grant for industrial development would be conditional on the guaranteed environmental safety of a development proposal.

Land use planning and management

The Kingdom needs assistance with the development of its own institutional capacity for the derivation of comprehensive, national, land use plans, in both urban and rural contexts. Planning in the broadest context would most usefully be directed initially to:

- development of coastal zone management plans, with Tongatapu as the first planning priority, within a framework for the eventual development of comprehensive land use plans for the Kingdom.

In the rural context, an initial aid emphasis is sought for:

- increased support for the development of sustainable agriculture, based on the fundamental importance of traditional agroforestry systems; and on the importance of high value, easily processed or transported export crops which can fit into the agroforestry systems, and have assured markets.

- increased support for tree establishment, particularly of multiple-purpose species within urban and peri-urban areas to meet firewood and other special food, cultural, or utility needs.

Environmental education

In widening the environmental debate to ensure greater public participation, the Government will look to the greater use of selected NGOs and, because of their central role in Tongan society, of the various church denominations as an educational conduit for environmental issues.
And an increased emphasis will be placed on the training of the lecturers at the USP and Community College, and of select staff of High Schools, on environmental opportunities appropriate to Tonga.

The tourism sector, however, is seen as a main channel for raising the level of debate on environmental issues. With tourism set to play an increasingly important role in the Tongan economy, tourism will be a major catalyst for sustainable development.

Tourism will be a vehicle for promoting further preservation of historic and archaeological sites, promoting cultural activity such as traditional dancing and production of handicraft and ensuring continued use of traditional architectural designs. Tourism may also support conservation action through the establishment of marine reserves; protection of attractive areas of vegetation; and the establishment of public parks and reserves, including botanical gardens. The development of tourist infrastructure will also accelerate waste management and pollution control planning in the areas of sanitation systems, garbage dumps, groundwater and monitoring for pollution of groundwater resources, agricultural produce and seafood.

Legislation

Contrary to conventional opinion, legislation can not be regarded in the Pacific as the solution to environmental problems. The main purpose of legislation in nations with small, closely-knit communities is the clear definition of the administrative powers and responsibilities of government agencies. That is important in itself. But the pragmatic view is that punitive powers, in the western model of fines and/or gaol sentences, are most difficult to enforce in small inter-related communities. Other models of communally applied sanctions for those individuals or businesses who unnecessarily damage the environment need to be developed.

And government agencies have a major responsibility in serving as role models for the public in encouraging ecologically sustainable approaches to development at all levels of society. To achieve this, some further changes in environmental perceptions may yet be needed within the framework of government, particularly to avoid the finger of public accusation being pointed at some government agencies as being the worst polluters of the lot.

SUSTAINABILITY ISSUES	CONSTRAINTS	OPPORTUNITIES
(1) **Population and human settlement planning:**		
	Inadequate information base on population issues.	Supplement the census with mini-surveys of environmental attitudes and resource use practices.
	Limited public perception of environmental problems and opportunities for sustainable development.	Inclusion of the environment as a subject within secondary and tertiary curricula. Community extension program on environmental issues. Hands on community participation in environmental activities led by church, school, and service organisations.
(2) **Land management-rural development and agriculture:**		
(a) Land planning.	Limited institutional capacity for land use capacity and suitability. Lack of comprehensive national land use planning, together with inadequate planning for urban development. Limited availability of additional land for increasing population within the constitutional land allocation system.	Establishment of a proper framework for national land use planning, including institutional strengthening. Greater enforcement of existing penalties of the Land Act for unused or misused land. Improved participation by landowners and the public generally in land use planning processes.
(b) Land availability and tenure security.	Insufficient use of arable land currently available for agricultural production. The high cost of securing leases of land or obtaining compensation for investments on leased land.	Review the Royal Land Commission on the Land Act. Re-appraise the land tenure system enshrined in the Constitution.
(3) **National resources and energy conservation:**		
(a) Resource value.	No pricing mechanism for encouraging resource and energy conservation.	Application of 'user pays' and 'polluter pays' principles.

(b) Chemical pollution.	Limited capacity for monitoring toxicity and persistency of agricultural chemicals, hormones and veterinary drugs. • Health Dept: Test for drugs, hormones and chemical residues in food and water. • Agriculture Dept: Toxicity and persistency of agricultural chemicals in soils and plants.	Improved laboratory facilities and increased trained staff for Health and Agriculture Departments. Increased emphasis on public awareness and education programs on agricultural chemicals, and medicines. Revision of legislation on importation, storage, safe use and disposal of hazardous chemicals, including pesticides.
(c) Marine resource conservation.	Traditional unimpeded access to any marine resource.	Public education and awareness campaigns on the unsustainable usage of marine resources. Reappraise public access to marine resources. Monitor catch and available stocks.
(d) Possible sea level rise.	Uncertainty of local impacts. Lack of public perception of sea level rise and limited official rethinking of usages of low-lying land. Limited incorporation into land-use planning.	Preparation of contingency plans for a range of inundation levels in low-lying or foreshore areas. Comprehensive coastal land-use planning.
(4) **Trade, industry and development investment:**		
(a) Balance of economic and environmental appraisal for project proposals.	Lack of specific environmental legislation, and specified mechanisms which ensure EIA.	Economic and environment appraisal of development proposals.
(b) Beach mining	Limited sand resource other than beaches	Increased emphasis on proving alternative sand sources. Reduced need for sand use in infrastructure development through use of alternatives to concrete block construction.

II. DEVELOPMENT TRENDS AND ENVIRONMENTAL IMPACTS

The Kingdom of Tonga lies between 15 and 23.5 degrees South Latitude and 173 to 177 West Longitude, and has an area of 390,128 sq.km. The Kingdom is an archipelago of 171 named islands with an area of 747 sq km, the 36 inhabited islands totalling 669 sq km. Six islands comprise three-quarters of the land area and contain 90% of the Kingdom's population of 94,649 (1986 Census: Department of Statistics, 1991).

There are four groups of islands extended over a north-south axis: Tongatapu and 'Eua in the south; Ha'apai in the middle; Vava'u in the north; and the small Niuas group in the far north. The capital, Nuku'alofa, is on Tongatapu.

Many of these islands are coralline in origin, comparatively flat and often encircled by fringing reefs. Some atolls are raised by tectonic action. There are also some islands of volcanic origin, notably in the west of the Ha'apai Group.

Easily accessible shallow-water reefs and shoals (less than 10 metres deep) cover about 550 sq km while an additional 3,045 sq km constitutes sea floor within the 200 metre shelf.

Tonga therefore can be considered to have about 1,200 sq km of readily accessible land and marine resources, 3,000 sq km of marine resource more difficult to utilise, and a pelagic and deep water zone of about 393,000 sq km. This deep sea zone will increase to an estimated 677,021 sq km (SPC estimate) when the final borders of the 200 mile EEZ are declared.

A. Natural Resource Endowment

1. Land

The Constitution of 1875 legalised the land use system developed during the 1779-1852 civil war period where families had a small area of land within a defensive fortification ('api kolo) where they lived, and a place outside in the bush where they could garden ('api 'uta). This pattern of land use continues today.

The Act of 1882 established the entitlement of each Tongan male over 16 years of age to both a town 'api not exceeding 0.4 acre(0.16 ha) and a garden 'api not exceeding 8.25 acres(3.3 ha). Title of the allotments is assigned by the Ministry of Lands, Survey and Natural Resources (MLSNR) and then becomes hereditary. All land in the Kingdom is Crown Land with four tenure categories: Hereditary Estates of a) the King; b) the Royal Family; and c) the Nobles and Matapule; with d) Government Land the fourth category. It is categories c) and d) from which the 'api allotments are drawn. In addition, land from any of the four categories can be leased, with the possibility of a single individual holding up to 10 'api for periods up to 20 years (1980 and 1983 Amendments to the Land Act).

A person can have only one town and one garden hereditary 'api. The land may not be sold, but it can, now, be mortgaged as security for a debt. Tenure is dependent on the fulfilment of a number of strict conditions. Among those conditions are two of specific environmental import: a) the allotment must be maintained in a 'reasonable' state of cultivation; and b) the land may not be 'abandoned' for more than two years.

The King, with the consent of Privy Council, can retrieve land from any holder for public purposes, in which case the dispossessed may be compensated with an offer of replacement land, money or both.

The distribution of land at 1986 is given in Table 2.1.

Table 2.1:
Land distribution of tenure categories (c) and (d) in the Kingdom of Tonga as at 1986

Use Category	% of total use
Registered 'api	43.6
Unregistered 'api	19.2
Government land	11.4
Leases	8.4
Nobles	6.9
Small islands	6.5
Lakes and Lagoons	4.0

Only 6.9% of all estates of the nobles remain to be distributed and of this more than 2000 acres on the 'Eua plateau though unsuitable for agriculture, have other potential development prospects such as forestry.

Most of the unallocated government land consists of lakes, marsh or mangrove swamps, cliffs, small islands with little or no water, and volcanic islands with little access and poor agricultural potential.

2. Agriculture

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

The Tongan farming system is essentially an agroforestry system of bush or grass fallow with cultivated coconut palms or other useful trees creating a multi-level overstory. The soils are inherently fertile in the main islands, being derived predominantly from an andesitic volcanic ash mantle overlying coralline limestone platforms.

These soils have excellent physical properties; they are friable, well structured, well drained have a moderate water holding capacity and range from slightly acid to slightly alkaline with high levels of calcium and magnesium, a high cation exchange capacity and high base saturation (NZ Soil Survey Reports 65-68, 1983-85; Potter, 1986). Hence these soils can support a wide variety of crops suited to the climatic conditions.

Although the Kingdom lies within the tropics, its climate is moderated by its maritime environment. On Tongatapu, the average annual temperature is 23° C with a maximum of 32° C and a minimum of 11° C. Rainfall averaged 1775 mm per year over the period 1950 - 1989. There is a distinct wet season from November to April. The prevailing winds are the south-east trades which blow for about three-quarters of the year. On Vava'u, it is much wetter with rainfall averaging 2289 mm per year spread over 146 raindays. The average temperature there is 25.1° C with a small variation from wet to dry season. High intensity-short duration rainfall can occur at any time of the year, but particularly during the cyclone season.

Most islands have gentle overland slopes with the exception of some steeper areas on the higher islands, such as 'Eua and Vava'u.

The main agricultural crops are coconuts, vanilla, bananas, squash, watermelon and root crops. The major root crops are yam, taro, sweet potato, cassava, kape and talo tonga. There was a marked decline over DPV in the tonnes of copra, coconut oil and copra meal produced; compared with 1985, production in 1989 was down by 74.8%, 81.0%, and 58.7% respectively.

The decline in relative importance of coconut products was particularly severe in 1988-89, reflecting in part the reduced output following a severe drought in the latter half of 1987. But output did not recover after the drought and the desiccated coconut factory closed down in early 1989. At the same time, while coconut products

declined, vanilla exports grew to 43% of agricultural exports. By 1990, 830 ha of vanilla had been planted, with 80% of the total area in Vava'u. The 27 tonnes exported in 1989 was valued at T$2.19 million.

Banana production declined drastically from 178,383 cartons produced by 244 growers in 1986 to 17,125 cartons produced by 143 growers in 1989. The value of export production declined from T$1.355 million to T$202,000. Sigatoka disease and fruit fly severely affected banana production in 1988 and exports were temporarily suspended in 1989 due to quarantine restrictions; the production decline was compounded by strong winds which affected much of the standing crop. With the November 1990 change in New Zealand import policy which removed the preferential treatment previously given to bananas produced in the South Pacific, banana production in Tonga as an export commodity will no longer be viable.

Tonga has ventured into large scale, intensive production of squash/pumpkin for the Japan export market and by 1989 there were 164 growers who exported 3013 tonnes. Marketing of this new export crop was problematical. However, because of the high potential earnings, it was necessary for the Government to subsidise growers to maintain growers' interest.

The period 1986-89 has seen a major increase in the value of exports of yam, taro, cassava and kape, particularly to New Zealand and Australian migrant communities. Value leaped from T$201,200 in 1986 to T$1.57 million in 1989.

Tonga is experiencing a problem of high labour cost for the agricultural sector. While there are many unemployed youth, unskilled, manual labouring employment is unattractive even at the high rural wage rates offered of T$2-2.50 per hour plus transport and food.

3. Forest resource

In accessible areas with arable soil, very little pure forest, per se, remains because of population pressures and more intensive forms of agriculture. Such areas have been gardened for hundreds or thousands of years, and the vegetation today is generally a mix of root crops and other horticultural crops, together with an open overstory of some preferred species of fruit, nut, medicinal, timber and ornamental trees. That is, an agroforestry system.

The main emergent vegetation in most islands is the coconut palm, between or under which other tree, shrub, herb and root crops grow. The dominance of the coconut palm is ensured by the Land Act which requires the owner of each tax 'api to plant 200 coconut palms and maintain them. A 1980 inventory by MAFF estimated that there were 5 million palms, but of which more than half were senile.

Only limited areas of indigenous forest remain in the Kingdom, primarily in very steep or otherwise inaccessible areas, in coastal littoral areas and swamps, or in mangrove swamps. The total area has been estimated at 4,000 ha, the bulk of which is found on 'Eua. The areas of better quality forest are restricted almost entirely to 'Eua and the volcanic island of Tofua in the Ha'apai Group, and the island of Late in Vava'u. Even then much of the forest is secondary with what might be classed as primary forest restricted to the cliff areas. Except for 'Eua, there is limited information on the botanical composition or timber resources of Tonga's remaining natural hardwood forests.

The resource inventory of 'Eua reported by Larsen and Upcott (1982) estimated that of the 3,779 ha forest reserve, 1,747 ha was designated as accessible forest, with a further 780 ha classed as "protected" forest. The forest reserve represents about 43% of 'Eua's total land area of 8,900 ha. However, the EMP reports (p92, s1.2.1) that "Most of the native accessible hardwood forest resources...have now been logged and the cleared land is being rapidly encroached by subdivision into tax 'api."

Thompson (1976) estimated that there was about 324 ha of forest on Tofua outside the crater which could be exploited (but there was no sheltered anchorage). The islands of Tafahi and Kao have undisturbed cloud forest on steep slopes, and other small, indigenous forests of note occur on Niuatoputapu and Late.

Mangrove forests are restricted to sheltered lagoon coastlines and are limited in size and of mediocre quality. Nevertheless they are locally important as sources of firewood, house poles and dyes for tapa cloth, as well as their extremely important biological role as marine nurseries.

Over the period 1977-85, Tongan government sawmills produced a base level of 1,200 cubic metres of timber per year, with a 1982 peak of 2,800 cubic metres, all for local use. The production from private sawmills is not known but would be quite small in volume. The production includes the recovery of sawn timber from felled senile coconut palms.

The bulk of the sawn timber demand is met by imports, with New Zealand supplying 73% of imports in 1987. Over the 1975-85 period, timber imports varied from a low of 1,800 cubic metres in 1979 to a peak of almost 10,000 cubic metres in 1982 (reconstruction following Cyclone Isaac), and about 7,000 cubic metres in 1985. The value of wood imports increased from about TD1.1 million in 1977 to T$2.9 million in 1985.

The fuelwood demand for Tongatapu has been estimated at 97,000 tonnes per year, about two-thirds of which is for household consumption. The preferred fuelwood comes from scattered large hardwood trees and shrubs growing on individual 'api. There is considerable concern over the decline in trees on Tongatapu and there is considerable potential for agroforestry and urban planting of trees for firewood.

The contribution of the forestry sector to the economy is very small at less than 0.2% of GDP. But the value of forest activity lies with the importance in which trees were traditionally held for soil maintenance, firewood, handicrafts and other uses.

4. Marine resources

The sea below the high tide line is also Crown property (Territorial Sea and Exclusive Economic Zone Act, 1978) and the rights to all resources (sand, dead coral, marine life) are vested in the Crown. Anecdotal evidence points to a long-standing tradition of common use of marine resources, and certainly common use is the practice today. Fishermen from other islands are expected and could fish on other's fishing grounds.

Compared with other areas of Polynesia, Tongan life is strongly land orientated rather than marine based. This fact was reported by Captain Cook (1784) and even at the turn of the century, Alexander (1902), in providing a detailed account of fishing practices of the time, reported that most people were farmers and fishing was less common than in other polynesian islands. In some villages, though, almost everyone fishes on a casual basis. The catch is distributed to the individual fisherman's family first, given to meet social obligations, and sold for cash. The bulk of fishing effort thus is for subsistence and for the local market.

The coastal reef area is subjected to a great deal of fishing pressure as a result and bottom fishing on seamounts and reef slopes is being encouraged by the government. The reef-slope zone has a potential harvest according to Langi and Langi (1988) of about 321 tons per year sufficient to support a maximum of 33 boats to fish the resource. However, at least 45 boats were fishing with the 1987 harvest at 716 tons. Legislation to regulate the fishery to stop the over-exploitation has recently been enacted.

Traditional fishing methods were fairly benign, using hand throw nets, spears, fish traps and poison to catch reef fish. Today, traditional fishing practices are still predominant in Tonga, but the introduction of more intensive fishing practices has entailed the use of modern equipment, some of which is highly destructive to the reef ecosystems.

Of course, in addition to fishing of the reefs, women, children and sometimes men gather a wide range of shellfish and other marine life from the tidal flats at low tide for consumption or production of shell handicrafts for sale to tourists. A 1983 survey in Vava'u concluded, on the basis of interviews of villagers and town officers that there was a decrease in variety and quantity of harvest, with shellfish smaller in size.

A summary of the estimated fisheries potential of the Kingdom's fisheries resources is given in Table 2.2 (from DPVI).

Table 2.2
Fishing zones, current catch and estimated fisheries potential

Fishing Zones	Area (Sq Km)	Current Annual Catch		Potential Annual Catch	
		Quantity (Tonnes)	Landed Values (T$'000)	Quantity (Tonnes)	Landed Value (T$'000)
Shallow reefs & lagoon zone	5,352	1,757	5,271	2,000	6,000
Inshore pelagic zone	41,010	150	450	200	560
Reef slopes & seamounts zone	1,420	430	200	200	560
Offshore pelagic zone	313,820	425	8,920	1,460	30,660

It is estimated that some 65% of all fish landings, including shellfish and crustaceans are caught in the shallow-water fisheries zone of reefs, lagoons and the inshore pelagic zone to a maximum depth of 75 metres. Many of the resources in shallow reef areas adjacent to villages and towns have been overfished and current landings are considered close to maximum sustainable yields.

Inshore pelagic zones which vary in depth from 75 m to more than 600 m and usually not exceeding 30 km from land are rich in small pelagic species of tuna, dolphin, mackerel and sardines.

Offshore pelagic fishing effort is concentrated to the west of the island groups where areas of upwelling occur and beyond the 6000 m contour. Resources of this zone comprise the large tuna species of albacore, yellowfin, bigeye, and skipjack. Marlin and sailfish are also common. Trolling is generally done when vessels move from one bottom fishing grounds to another.

Albacore tuna is the most highly valued and most abundant species of the zone. The resource remains largely untapped and offers future earnings potential. A government fishing vessel "Lofa" has been profitably fishing the albacore resource for the past nine years.

The reef slopes and offshore seamount zones comprise the deep-bottom fishing grounds in depths from 75 m to 1000 m. Deep water fishing for snapper by bottom handlining has grown significantly and is considered by the Fisheries Department to be sustainable at current harvest rates. The species is valued by the Hawaiian market.

5. Water

Water is a critical resource for the small widely scattered islands of the Kingdom of Tonga. For most of Tonga's populated islands, the water resource is either rainwater stored in concrete tanks, or a thin lens of fresh water on a highly porous limestone substrate.

The volcanic islands have small groundwater aquifers, and there are some freshwater lakes and springs. Volcanic 'Eua has one ephemeral stream and several ephemeral lakes along its eastern ridge. The groundwater supplies on 'Eua come from caves high above sealevel.

Small coral islands less than 400 metres across have no fresh groundwater. On the remaining coralline islands, there are no streams and water is drawn from a freshwater lens floating on top of the salt water. The shape and size of the lens is governed by rainfall volume and periodicity, tides, seepage, hydraulic conductivity and rate of abstraction.

A bore or well tapping the freshwater lens should be located in the thickest part of the lens and pumping should be continuous and at a rate such that the thickness of the lens is not reduced to less than half the original thickness. Thus the pumping water level must be closely monitored. When the cone of pumping depression intersects sealevel datum, sea water will upwell into the bore. Once contaminated with sea water, the well may take years before the delicate freshwater:saltwater balance is re-established (Dale and Waterhouse, 1985). Apart from vulnerability to saltwater contamination, the groundwater lens is vulnerable to contamination from surface pollutants which percolate down to the lens.

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

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

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

In Ha'apai investigations have located supplies of fresh water close to the main reticulated area in Pangai. Further studies will identify the number and location of wells which will replace the existing salty water supply. Similar studies are being carried out on 'Uiha, Foa and Ha'ano. The results are being used in the Tonga Water Supply Master Plan Study to develop a model for village water supply in similar villages.

6. Minerals

There are no known commercial deposits of gold or any other valuable mineral in the Kingdom. Nor is there any proven hydrocarbon resource although oil exploration commenced in Tongatapu in the late 1960s. Extensive seismic surveys were conducted during the DPV period in the Lau basin which is considered by geologists as a promising area but no oil was found. Subsequently a major review of the oil potential was undertaken which aimed to regenerate further oil exploration, and new exploration activity is imminent.

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

The Holonga quarry which was used to supply the Lupepau'u airport with building material contains very hard reef structures which may prove useful for the production of sawn building blocks. The Pangaimotu quarry also has hard well-cemented segments of reef.

Quarrying is carried out by digging, blasting and ripping the foraminiferal and fossil coral from hillsides. No attempt has been made to cut limestone for building blocks as has been done elsewhere in the region.

Sand is used to make aggregate for cement and consequently with modern construction activity there has been a rapidly increasing demand. Large quantities of sand are also used traditionally for covering graves in the public cemeteries.

Sand is surface mined from beaches by heavy equipment and a number of beaches are now stripped to the rock substrate as a result, including beaches like Monatapu Beach which was once a popular tourist area. In

Tongatapu and Vava'u, most of the sand is mined by the MLSNR and then sold to the public. Great amounts of sand are still taken by individuals despite a law forbidding unapproved sand removals.

Sand surveys have been conducted for the past decade to locate marine or terrestrial beds of sand for construction purposes. Many deposits have been considered but the sand either proves to have too much silt or is fragile. A suitable aggregate for cement may be obtained by crushing limestone, but this practice has not yet been introduced to Tonga.

7. Energy

In his opening address to the Inter-departmental Environment Committee Symposium, 27 August 1990, the Hon. Dr S. Ma'afu Tupou, Acting Minister for Lands, Surveys and Natural Resources said:

> "The crisis in the middle east will have profound implication on the meagre resources of regional countries, more especially where much of the accumulated foreign exchange (is) spent on acquiring oil. If we felt the crunch in 1973 we shall surely feel once more the oil crunch albeit we are but bystanders to the terrible events in the middle east. It brings into sharp focus the vulnerability of small states not only to the political whims of larger states but in terms of one's sovereignty and territorial integrity. For small island countries there is now an urgency to give considered reflection as to the type and form of energy resources which might be safely used in addition to petroleum."

Events have re-enforced Dr Ma'afu Tupou's remarks with international oil prices exceeding $US40 a barrel for a period and with consequent enormous price escalations for petrol and all petroleum-based products. These prices were not maintained and oil is now back to near pre-war levels; but had prices been maintained, Tonga would have suffered a severe foreign exchange loss which would have forced a drastic curtailment of the already constrained ability of government to meet recurrent expenditure costs, let alone new development or improved services.

And any prospects for increasing financial and manpower resources for environmental administration and management would diminish accordingly.

While the Iraq War is over, another oil crisis could develop quickly for many reasons. Thus the South Pacific region would be wise to heed Dr Ma'afu Topou's warning. For the small island nations, increased emphasis must be given urgently to reducing the level of reliance on imported petroleum products.

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

Electrical generation capacity has increased greatly over the past decade, although there are still non-electrified villages in the outer islands. All electricity generations are diesel-powered generators. Firewood comes from any available source, including tax 'api, mangroves, dead windfall branches, construction offcuts, and coconut. On Tongatapu, good fuelwood is rapidly becoming scarce and small bundles of preferred firewood species command T$5 in the Nuku'alofa market, much of it ferried in from 'Eua.

B. Patterns of Economic Growth

The trend of economic growth has declined during Development Plan periods III, IV, and V, spanning the period 1975-1990. The average growth rates for each period, respectively, were 3.7%, 3.4% and 0.05%. The estimated average annual growth rates for each of DPs III, IV and V is given in Table 2.3 below (from DPVI). Tonga expected to achieve a GDP growth rate of almost 5% during DPV, but real GDP growth did not achieve that goal.

Table 2.3
Estimated real GDP growth by sector (average annual growth rates, in %)

Sector	DPIII	DPIV	DPV*
Agriculture, forestry, & fisheries	0.2	0.0	-0.4
Mining & Quarrying	4.2	-1.3	3.5
Manufacturing	5.7	4.4	1.1
Electricity & Water	12.2	9.8	6.2
Construction	13.6	24.7	-6.0
Trade, cafe & Hotels	3.0	3.3	-1.0
Transport & communications	21.3	-0.9	2.3
Finance & business services	4.0	5.0	2.5
Community & personal services	4.2	6.7	0.9
GDP at market prices	3.7	3.4	0.05
Net transfers & factors income	n.a	8.9	-0.5
Disposable income	n.a	4.7	-0.9
Disposable income per capita	n.a	4.2	-1.3

* Data for DPV period do not include 1989-1990 financial year estimates.

In terms of growth, the agricultural sector was stagnant over the 14 year period. Economic growth in most sectors has declined over the DPV period to the point where it is almost negative; to a certain extent this is attributable to the lack of growth in the agriculture sector, the sector which makes the dominant contribution to GDP.

Table 2.4
Contribution to GDP at factor cost (in % of GDP)

Sector	DPIII	DPIV	DPV*
Agriculture, forestry, & fisheries	50.2	31.2	30.5
Mining & Quarrying		0.1	
Manufacturing	5.3	3.5	4.6
Electricity & Water	0.9	0.8	1.2
Construction	3.6	9.4	6.6
Trade, cafe & Hotels	13.4	10.4	10.7
Transport & communications	3.7	6.5	6.5
Finance & business services	7.3	5.3	6.1
Community & personal services	15.1	12.6	11.8

Table 2.4 compares the contribution to GDP (at factor cost) of the various sectors within the economy over the DPIII, DPIV AND DPV periods. The declining importance of agriculture to GDP is indicated in Table 2.5 below.

Table 2.5
Estimated real GDP growth during the DPV period

Sector	1985-86	1986-87	1987-88	1988-89
GDP%	0.8	-0.1	-2.0	1.5
Non-agricultural GDP	1.2	-0.7	1.4	0.4

1. Sectoral growth patterns

Agriculture

It has already been said that Tonga has a small economy dominated by semi-subsistence, smallholder agriculture.

At the end of the DPIV period, the natural resources sector (agriculture, forestry and fisheries) was estimated to contribute more than 40% of GDP. And it was expected this sector would increase by an average 15% per annum during DPV. Table 2.3 above indicated a zero average growth rate for DPIV and a small negative rate for DPV. Developments in 1989-90 for the banana and coconut product industries do not offer strong promise of a reversal of the decline in importance of agriculture to GDP.

Vanilla growing is one of the brighter components of Tongan agriculture, although difficulties were experienced during DPV with husbandry and marketing. While market prices declined in 1989, earning expectations remain high and vanilla remains an attractive crop to growers. The export performance for root crops is also encouraging, with the markets far from saturated, but stiff export competition is faced from other Pacific nations for taro and cassava.

Fisheries

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

Manufacturing

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

As with the agricultural labour market, it appears that Tongan unskilled labour is not prepared to perform menial jobs for low wages. The subsistence economy appears to absorb the large so called unemployed. There is a large pool of willing labour for the medium skill, primarily comfortable office jobs, but a shortage of skilled, experienced Tongans for the more senior roles in the bureaucracy and private industry. The highly skilled group tend to be attracted to better paid employment and work conditions overseas for some years, although many return to Tonga eventually.

Tourism

Air arrivals averaged 6.4% over the 1983-89 period with 21,000 in 1989. Of these, tourists comprised about 60%. The estimated value of tourism in 1989 was T$11.5 million, and the sector has become a major component of the economy with every indication that the rate of growth will continue, given quality tourist and the availability of supporting infrastructure. Tourism is now a significant employer and the hospitality trade will attract increasing numbers of school leavers as the industry expands.

Construction

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

2. Household expenditure and income

Household expenditure exceeded household domestic income by an average of 42% during DPV. This reflects

the level of private remittances from abroad, and personal or housing loans.

Private remittances from abroad have declined in real terms at an average annual rate of 6.5% during the 1986-89 period, and there is anecdotal evidence to suggest that the level of remittance has tapered off sharply since then as the recessions in Australia and New Zealand hardened and affected the capacity of emigrant family members to continue their previous level of monetary support.

While remittances declined, personal savings grew at an average annual rate of 4% at constant prices. This suggests there may have been a forced change in consumption patterns and household expenditure. Furthermore, the substantial growth in personal and housing credit to households could also be explained by decreasing remittances from abroad and the need to borrow to maintain a standard of living previously supported by remittances.

3. Investment and consumption

Total investment throughout the 1986-90 period represented an annual average of 22.5% of domestic income as measured by GDP at market prices. The total investment was also equivalent to 31% of total final consumption. Investment expenditure over the five years did not grow in real terms. This lack of growth is mainly attributed to a decreasing trend in private investment. Industrial and commercial construction expenditure declined sharply over the period at an annual average of 12%. Direct foreign investment remained small in proportion to total private non-housing investment.

Table 2.6
Growth of investment, consumption and related variables over the DPV period (1985/86-1989/90)

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

4. Balance of payments

A substantial and growing deficit in the balance of trade was matched by a surplus in the services and transfers account. There were wide variations in the current account balance.

Exports declined in proportion to imports. In the late 1960s, export receipts covered two-thirds of import expenses; this ratio decreased to 36% at the beginning of the 1970s, then to 24% by the end of the 1970s and to 18% by the end of the last decade.

The strong demand for imports continues, supported by the growth in foreign aid and private remittances, with the latter the single most important item in Tonga's external account.

Table 2.7
Balance of payments: annual averages (in T$ millions)

Sector	DPIII	DPIV	DPV*
Balance of trade	-19.4	-30.9	-47.7
Exports	6.1	7.2	10.4
Imports	-25.4	-38.1	-58.2
Balances of services and transfers	15.5	31.7	44.7
Tourism receipts	4.7	5.6	10.8
Other services (nett)	-0.2	-4.2	-8.2
Remittances (nett)	11.4	23.5	32.9
Development aid (nett)	-0.4	6.8	9.3
Current account balance	-3.9	0.7	1.4
Capital account balance	5.3	2.4	-0.5
Increase in reserves	1.4	2.8	1.8

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

5. International trade

Imports

The growth in imports during the DPV period 1986-90 (nominal imports deflated by the import component of the CPI) grew steadily from $60.3 m in 1985/86 to $72.7 in 1989/90.

Table 2.8
Total imports growth, 1985/86-1989/90 (T$m)

1985/6	1986/7	1987/8	1988/9	1989/90
60.32	65.56	68.70	68.83	72.69

Exports

Table 2.9 below clearly illustrates the fundamental change over the past five years in the Tongan economy with a decline in the value of agricultural exports and a rapid rise in the value of manufactured exports. The agricultural export value is now expected to flatten out, with some value recovery as the recently planted vanilla crops come into production. Fish increased steadily until 1989 and then fell back to 1988 levels; the value of these exports is realistically expected to grow with the development of the albacore tuna industry. And the Small Industries Centre has been successful in improving export manufacturing, with a significant leap in 1990 (particularly in knitwear manufacture).

Table 2.9
Exports of major commodities, 1986-90

in T$'000	1985-86	1986-87	1987-88	1988-89	1989-90
Coconut prod.	2,994	2,934	1,829	1,522	832
Vanilla	1,182	1,418	1,191	2,504	829
Bananas	1,041	1,859	797	517	185
Watermelon	195	2	16	6	15
Root crops	280	353	544	865	1,823
Fish	649	1,249	1,292	2,048	1,445
Manufacturing	1,045	1,419	1,864	3,060	3,420
TOTAL	**7,386**	**9,234**	**7,533**	**10,522**	**8,549**
Composition of exports (%):					
Agriculture	77	71	58	51	43
Fish	9	14	17	20	17
Manufacturing	14	15	25	29	40

Trade Partners

Australia and New Zealand dominated the trade pattern of Tonga's exports and imports. Other trade partners included, United States of America, United Kingdom, Singapore, Japan and Fiji. There is a growing export trend to the United States of America and Japan.

6. Revenue and recurrent expenditure

By the end of the 1980 decade, government expenditure was rising faster than revenue; in 1989-90 expenditure was 4% greater, due mainly to a major increase in recurrent expenditure that financial year from a 34% increase in civil service salaries. Over the DPV period, recurrent expenditure grew 5.2% per year faster than recurrent revenue, at constant prices. The recurrent balance was in deficit throughout DPV, with the exception of 1987-88.

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

The trend in recurrent expenditure over the eight year period, 1982-1990, has been for greatly increased expenditure on government administration (+16.5% -as % of total outlay), with a 16% decline in economic services and a 3.5% decline in social services. At constant prices, government expenditure in economic services fell over DPV by an average of 6% per year, a result which the government intends to counter during DPVI.

The maintenance of recurrent expenditure over the period 1982-1989 at a fairly constant 20% of GDP was only

achieved through the imposition of additional revenue measures and fiscal constraint. The income tax base was radically restructured; marginal tax (sliding scale) on personal income was replaced by a flat 10% rate across the board and company tax for resident companies reduced. Indirect taxes were increased, including the introduction of a 5% sales tax, resulting in a 72% increase in indirect tax revenue over DPV.

7. Internal lending pattern and debt

The Tonga Development Bank which was established in 1977 has the key development functions of identifying and promoting new ventures, providing short, medium and long-term loans, providing technical, managerial and financial consultant services, provides financial guarantees to other lenders, and takes equity participation in ventures. The maximum loan repayment period is for 15 years, but most loans are for shorter periods and for sums less than T$1,000. Priority is given to labour-intensive projects.

Loan approvals for the period (1986-90) are given in the tables below, by Sector in Table 2.10, with a breakdown for the agricultural sector in Table 2.11.

Table 2.10
Loan approvals by sector, 1986-1990

Sector	T$ (millions)	% of total loans
Agriculture & fisheries	19.67	47.5
Manufacturing & processing	2.93	7.1
Mining & quarrying	0.74	1.8
Electricity & gas	0.41	1.0
Construction	1.03	2.5
Wholesale & retail trade	4.64	11.2
Tourist infrastructure (hotels & restaurants)	5.53	13.4
Transport	3.83	9.3
Finance & business	1.35	3.3
Community services	1.24	3.0
TOTAL	**41.39**	

Table 2.11
Loan approvals for the agricultural sector, 1986-90

Commodity	T$ millions	% of total agric. loans	% of total approvals
Vanilla	5.81	29.5	14.0
Bananas & other fruit	0.73	3.7	1.8
Vegetables (incl. squash)	4.51	22.9	10.9
Root crops	4.93	25.1	11.9
Livestock	0.95	4.8	2.3
Fisheries	1.86	9.5	4.5
Others	0.88	4.5	2.1
TOTAL	**19.67**	**100**	**47.5**

The 47.5% share for the agriculture and fisheries sector reflects the critical importance of the sector and the need for financial support. The 13.4% share for tourist infrastructure reflects the high priority accorded tourism by the Government.

In 1987, 37.3% of loans and advances of the Bank of Tonga were for housing, and 16.2% for personal loans. This bank's share of loans for agriculture was 6.4%, a significant increase over the 1.2% share in 1985.

8. External debt

External debt rose only slightly in real terms over the DPV period, with the main increase being in the area of multilateral debt. The increases in external debt for 1982-89 period seen in Table 2.12 are also a reflection of the depreciation of the Australian dollar, to which the Tongan dollar had been pegged, against the US dollar, the currency in which most of Tonga's foreign debt is payable. The debt service ratio remained small, under 3%, because most external borrowing has been on favourable terms.

Table 2.12
External debt and debt service, 1982-89

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

9. Development assistance

Aid contributes about 27% of the GNP, with Australia the largest donor, followed by Japan, EC and New Zealand. A number of other countries have bilateral technical cooperation arrangements. Multilateral and regional agencies with assistance programs in Tonga include ADB, IFAD, ILO, UNEP, SPC and UNDP.

Official aid has become an important source of funds for the economy, exceeding the level of exports during the DPV period (See Table 2.7). Development expenditure over DPV totalled T$111 million in current prices. Over 60% was incurred directly by aid donors (ie offshore), not passing through government accounts; and of the onshore finance (from domestic sources, or foreign loans or grants going through government accounts), 63% was foreign, mostly in the form of bilateral aid from Australia and New Zealand, and loans from the Asian Development Bank and the European Economic Community. Two thirds of the bilateral aid came form Australia and New Zealand.

C. Demographic Trends

The Tongan people are Polynesian in origin and the socio-political order is a blending of traditional Polynesian elements and Western influences. The social structure has three tiers consisting of the Royal Family, nobility (33 nobles) and the people.

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

Over the past 50 years there has been a pattern of increasing urbanisation of the people, seen not only through emigration to urban centers overseas, but also through migration from the outer islands to the Greater Nuku'alofa Area, and from rural areas of Tongatapu to the capital.

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

1. Population distribution and growth

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

Table 2.13
Population by Divisions and growth rates for the 1976 and 1986 Census

Census Division	Population		Annual rate of growth (%)
	1976	1986	
Tongatapu	57411	63794	1.1
Vava'u	15068	15175	0.1
Ha'apai	10792	8919	-1.9
'Eua	4486	4393	-0.2
Niuas	2368	0.2	-0.2
TOTAL	**90085**	**94649**	**0.5**

The sex of the population in 1986 was 47,611 males and 47,038 females, a sex ratio of 101.2. This compares with a sex ratio of 104.5 in 1976.

Assuming that the growth rate was constant over the decade 1976-1986 between the two censuses, the average annual growth is estimated at 0.5%. A number of the more important factors which influence this rate, including migration, are discussed later in this section. The Divisional breakdown into Districts at 1986 is given in Table 2.14.

Table 2.14
Population by Divisions and Districts for the 1986 Census

Division/District	Number	Division/District	Number
Tongatapu Division	**63794**	**Vava'u Division**	**15175**
Kolofo'ou	15903	Neiafu	5268
Kolomotu'a	13115	Pangaimotu	1247
Vaini	11104	Hahake	2299
Tatakamotonga	6773	Leimatu'a	2884
Lapaha	7005	Hihifo	2093
Nukunuku	5863	Motu	1384
Kolovai	4031		
'Eua Division	**4393**	**Ha'apai Division**	**8919**
'Eua Proper	2400	Pangai	2850
'Eua Fo'ou	1993	Foa	1410
		Lulunga	1584
		Mu'omu'a	885
		Ha'ano	891
		'Uiha	1299
Niuas Division	**2368**		
Niuatoputapua	1605		
Niuafo'ou	763		

2. Migration

External migration

The average annual intercensal growth rate of 0.5% reflects the high level of overseas migration. While a detailed demographic analysis of the 1986 census is not yet available, the data indicate the birth rate was about 30 live births for every thousand people. The current death rate can be assumed to be about 6-7 deaths per thousand population. Thus the natural increase is about 23.5 per thousand (or 2.35%). The net overseas migration rate (rate of natural increase - intercensal growth rate) is then about 1.85%.

If this migration rate is applied to the census population, a nett outflow of about 17,500 people occurs each year. Recent studies of passenger manifests for arrivals and departures suggest that current emigration rates are even higher. Because the census figures are averages over a ten year period, this suggests also that emigration may be higher now than it was 10 years ago.

Internal migration

While the census can provide only limited information about the nature of migration overseas, it does provide more precise information about movement within the Kingdom. Nett annual migration rates are given in Table 2.15 and the pattern of internal migration is illustrated in Figure 1 (prepared by Mr Don Seiler of the Ministry of Finance).

Of the 94,649 population at the 1986 census, 61,650 returns were analysed to determine the pattern of internal migration over the 10 year period. The persons excluded from analysis were: non-Tongans; children born since the 1976 census; persons now resident but overseas in 1976; and Tongan visitors in 1986 who were residents in 1976. The 61,650 persons comprised 30,425 males and 31,225 females.

Table 2.15
Nett migration and mean annual migration rates

Division	Non-Movers	Net Exposed Migrants Populat. (*)	Mean Annual Nett Migration	Rate %
Tongatapu	36622	+1332	39150	3.4
Vava'u	9961	-207	11564	-1.8
Ha'apai	6005	-953	7921	-12.0
'Eua	984	-353	1184	-29.8
Niuas	1470	+181	1831	+9.9

* -The exposed population is the sum of the non-movers and the out migrants at the 1986 Census.

Table 2.15 summarises the effects of movement between census divisions. Tongatapu gained with net in-migration of 1332 persons; Niuas also gained 181 persons. 'Eua and Vava'u both lost people during the 10 year period, but most of the migrants came from Ha'apai.

The mean annual nett migration rate per 1000 population (expressed above as a percentage) provides a more realistic measure of the impact of internal migration. Generally speaking, the smaller the population of the Division, the greater will be the effect of migration on growth. Tongatapu has a high nett in-migration, but as a rate it is small; the rates for the Divisions with smaller populations like 'Eua is extremely high.

The nett migration rates also illustrate the factor of distance decay; those islands closer to Tongatapu will have larger migration streams than those further away. The Niuas situation is a special one of earlier residents who vacated the Division later returning home. The nett migration streams between Divisions is illustrated in Figure 1.

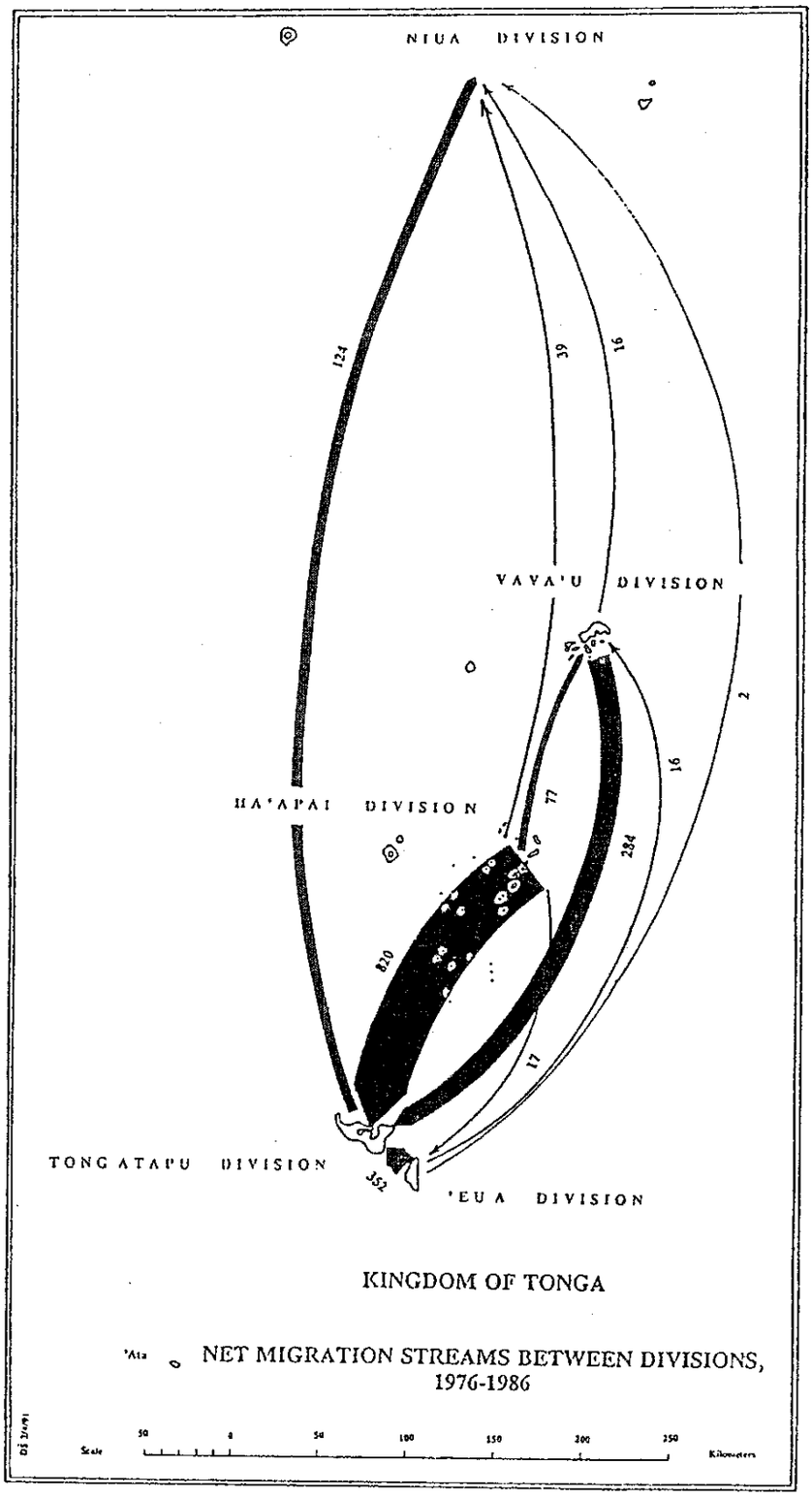
The age pattern of migrants is to be expected given the attraction of education and employment opportunities. The largest gain is for the age group 15-24 and to a lesser extent for ages 10-14.

The census also indicated that while the stream of migrants from rural Tongatapu to Nuku'alofa is fairly high, these migrants are more likely to return than migrants coming from distant islands. Nett migration to Nuku'alofa was +7 from rural Tongatapu compared with -1332 for the other Divisions.

Table 2.16
Migration by age groups, 1976-86

Age group Nett	Nuku'alofa Nett Migration	Rural Tongatapu Migration	Other Divisions Nett Migration
10-14	+279	+63	-342
15-24	+732	-34	-698
25-34	+39	-21	-18
35-49	+144	+30	-174
50 and over	+126	-31	-100
TOTAL	**+1325**	**+7**	**-1332**

Figure 1. **Nett migration streams between Divisions of the Kingdom of Tonga**



Of the migrants to Nuku'alofa, females were in the majority, 4628 females compared with 4332 males; this is the reverse of the more common migration pattern in other countries. This may be accounted for by a higher proportion of males migrating overseas, 60% of the persons who stated they had lived overseas at some time for at least 6 months being male. Of the 66,023 respondents who claimed they were born in Tonga, 25% were classified as lifetime migrants; that is, their usual place of residence is in another Division from their place of birth.

The environmental significance of the pattern of internal migration, particularly the effects of increasing population on the limited land availability in the environs of Nuku'alofa for immigrants is discussed separately under Section IId and elsewhere in the report.

3. Religion

Religion is very important socially as well as spiritually in Tonga, with almost all Tongans claiming to be adherents to the Christian church. Religious adherence of Tongans is tabulated below.

While the Free Wesleyan Church remains by far the dominant denomination, there was a fall in the number claiming adherence over the census period, as also for the Free Church of Tonga. In contrast, there was a relatively large gain in members of the Church of Jesus Christ of Latter-day Saints (Mormons), and to a lesser degree also of the Tokaikolo Christian Church which is the main group in the 'Other' category.

Table 2.17
Religious adherence of Tongans, 1976 and 1986

Religious Denomination	1976 (%)	1986 (%)
Free Wesleyan Church	47.5	44.1
Roman Catholic Church	16.2	16.3
Church of Jesus Christ of Latter-day Saints	9.3	12.3
Free Church of Tonga	13.7	11.4
Seventh Day Adventist Church	2.1	2.3
Anglican Church	1.0	0.6
Other	1.3	5.5

The environmental significance of religious adherence is twofold: the centrality of the churches in the everyday life of Tongans makes them a powerful vehicle for transmission of the environmental conservation message: and, secondly, one of the major churches, the Mormons, has not been admitted into the fold of the Council of Churches and hence any use of the Council as a single liaison point with the religious fraternity as a means of raising public awareness and participation will neglect a significant portion of the population.

4. Education

Few persons fail to attend school at least at the primary level. Consequently there is a very high level of literacy - 99.6% in the 1976 Census. While a strict comparison cannot be made between the two censuses for education, it is reported that education attainment improved considerably over the decade, with the numbers going on to secondary school (55.8%).

5. Employment

For convenience, the Census report divided the population of work force age into three groups: employed, unemployed and not economically active. About 51% of the people aged 15 and over was economically active.

Not economically active

This category includes those persons who spend some time engaged in economic activities but claim their main activities are non-economic; about two-thirds of those claiming to be housewives engage in some agricultural work or cottage industry. Another 19% claimed to be fulltime students.

Unemployed

About 9% of the economically active group said they were unemployed, the unemployment level varying from 10.7% in Nuku'alofa to 8.2% in the rest of the country. There was a large difference between the sexes, with a male unemployment rate of 6.4% and a female rate of 18.7%. Male unemployment in Nuku'alofa was 9.3%.

Apart from the difficulty of finding work in the wage sector, unemployment was most pronounced among young people as they seek employment in line with their education and expectations. The unemployment rate for 15-19 year old males was 27.6% and more than 50% for females of the same age group. Unemployment among youth of Tonga has become a major social problem. At the same time, it should be noted here that there is a developing labour problem in Tonga, with labour shortages in the commercial agricultural sector and in other industries such as food processing which require numbers of menial labour.

Employed

About 50% of the employed population were in paid employment; 36.8% were subsistence farmers, the majority of which produce for subsistence only although large numbers also sell some of their produce; 7.2% in cash-cropping; and 5.4% in a family business.

Omitted from the employed category are those women who work in gardens, on farms, or sell food at the market but at the same time undertake a range of domestic household tasks. These were classified as 'home duties' in the unemployed category.

More than 75% of employed persons in the Nuku'alofa area had paid employment, while a further 8.2% were either temporarily on leave; or worked in a family business. In the rest of the country, less than 40% worked in paid employment; most others worked in the agriculture sector.

D. Natural Resource and Environmental Issues

1. Land availability

Land availability under secure title for investing in agricultural production, or for the construction of new dwellings in the main urban centres, is arguably the most pressing social problem for Tonga. The shortage of land has led to a number of unsound land use practices which have serious environmental consequences in both the short and long term.

With increasing population and urbanisation, available town and garden land has been allocated. MLSNR estimates that about 75% of eligible people do not have a tax 'api. However most people do have access to garden land; people without legally allocated tax 'api often use the lands of friends or kinsmen or lease land from the government or nobles.

Population increase and migration to the urban centres forces government to allocate new land; as all useful

agricultural land is already allocated, there has been a tendency to subdivide and register environmentally sensitive lands or land with low productivity or hazardous potential. This includes mangrove areas, swamps and marshes.

It is claimed that the unavailability of 'api to much of the younger generation encourages emigration because of the reduced future prospects in Tonga. But the limited availability of employment in Tonga at a level commensurate with the fairly high level of education must also be a factor encouraging emigration.

The development of more intensive agricultural production systems is discouraged also by the small size of the garden 'api; but this can be regarded as a mixed blessing. The general level of soil fertility has been maintained and erosion minimised by the necessity for many farmers to continue the traditional agroforestry production system. Had it been possible many years ago for large areas of land to be cleared and cropped using more intensive agronomic methods, particularly the continued use of agricultural machinery, then the land might be in much poorer condition today than is the case.

It must be noted that the Tongan land use system has protected its citizens from the economic, political and environmental problems experienced in other South Pacific states where the best agricultural land with the easiest access was often alienated from indigenous people for conversion to monoculture plantation agriculture.

But the position now is that without more efficient use of land already allotted, land pressures must lead to environmental deterioration as mangroves are landfilled and "reclaimed", fallow periods reduced and continuous cropping of the soil has been attempted. The safety valve for the population increase is the ability to emigrate relatively freely within the region; should this be curtailed for a variety of reasons then the land availability problem in Tonga will escalate rapidly.

2. Agriculture

In most of Tonga today, as for centuries past, farmers practice a swidden agriculture which has evolved into a sophisticated form of agroforestry. Trees of desirable fruit, nut, ornamental, medicinal or other traditional use are retained when an area of the 'api is cleared, coconuts established as necessary, and other shrubs, herbs, vegetables and root crops planted in a multi-canopy structure for short cultivation periods followed by bush fallow to allow the soil to recover its fertility.

The continued high rates of productivity from the 'api over what is claimed to be thousands of years testifies to the sound environmental strategies of traditional agricultural practice.

However, as the community moves away from a predominantly subsistence life-style to greater cash cropping activity, agricultural practices can intensify to an extent that longer term cropping sustainability may be severely impaired. Such impairment cannot be assumed, though, in the Tongan situation, because most soils are derived from volcanic ash and consequently are friable, well-drained, generally of adequate nutrient status without the need for major application of mineral fertilisers, and capable of sustained production for a wide range of crops.

On the other hand, there is greater risk of fertility impairment where repeated mechanical tillage is practiced, soil structure is damaged and compaction occurs. This would be one risk of continued attempts at large-scale intensive horticultural production.

Intensive agriculture need not be associated with any long term loss of productivity of course. Some intensive forms of farming systems, such as for the production of vanilla and pepper, can be quite compatible with a traditional agroforestry system and, except for the introduction of fungal diseases and pests, the question of sustainability should not arise with such crops.

As farming practices intensify, however, farmers have been warned by MAF to take special care to maintain levels of organic matter. With the high levels of calcium and magnesium in the ash soils, the retention of

organic matter is necessary if adequate potassium is to continue to be available to plant roots. Farmers have also been warned by MAF to be cautious in their use of mechanical cultivation which might break down the soil structure.

With intensification of root crop or cucurbit production, trees are seen as an obstruction for mechanical ploughing and the traditional retention of trees is being modified, with a tendency to keep trees as an 'api border rather than randomly scattered throughout the 'api. With the increasing land pressure, bush or grass fallow periods are shortening and continuous cropping periods are extending, accompanied by an increasing use of chemical fertilisers. And accompanying increased fertiliser use is increasing use of biocides (insecticides, fungicides, nematicides and herbicides).

Agricultural chemicals

It is with agricultural chemicals that the greatest risk of environmental pollution arises from farming activity in Tonga. Public Health has very limited capacity to monitor for chemical residues, drugs and hormones in food to protect consumers. And the MAF has no capacity to carry out toxicity and persistency tests of agricultural chemicals in soils and plants in order to safeguard the public from indiscriminate use of farm chemicals.

The MAF considers the public have only limited awareness, at best, of the inherent dangers in both the application of agricultural chemicals and in the consumption of food containing toxin residues.

3. Forest resource

Mangroves

Due to the limited availability of land, mangrove areas in Tongatapu and Vava'u have been subdivided and some already cleared and filled to make home sites. The EMP reports that such land is rarely filled to a sufficient height to escape the danger of flooding during storms or even from unusually high king tides. As a result, in addition to property loss, sewerage is inadequate and severe health hazards can arise due to flooding of pit latrines and septic tanks. Swamp forests likewise are being reclaimed through land-fill and divided into 'api.

Coconut palm utilisation

Because of the large numbers of senile coconut palms there has been an emphasis in recent years on improving the rate of utilisation, recovery level and use of the palm trunk to augment supply of sawn timber for the local market.

While this policy appears a sensible conservation measure to reduce resource waste, close study of the economic viability of the operation should be undertaken, in particular a comparison of the economics of a larger central sawmill operation (Mataliku Sawmill Centre) and the use on outer islands of the small, low-capital, lower maintenance, portable sawmills. The latter could be expected to play a valuable role as a community resource to supply local village lumber needs.

Working against an economic operation for a larger coconut sawmill facility, however, is the small diameters of the senile palms in Tonga (compared for example with coconut palms in the Philippines) with their high handling costs and low levels of sawn timber recovery, together with the relatively high labour wage structure in Tonga.

In theory, a replacement rate of 80,000 senile coconut palms per year would yield about 15,000 cubic metres of sawn timber (Larsen and Upcott, 1982) which would meet local timber needs. This prospect, however, appears quite unrealistic.

Timber treatment

One utilisation issue in Tonga arises from the use of CCA salts (copperchrome-arsenic) for timber preservation treatment at the Mataliku Sawmill Centre in Tongatapu. These salts are widely used throughout the sawmill industry to protect sawn timber from fungal decay and termite attack.

The salts can be quite toxic if the prescribed safety practices are not faithfully followed, and more so as chrome and arsenic have cumulative effects. The use of gloves, heavy duty aprons and masks to protect the sawmill worker from direct chemical contact are basic protection measures, but, in practice, difficult to enforce in a hot climate. The timber industry is searching for effective timber preservatives which have a lower health risk.

Reforestation and urban forestry

The pattern of limited local wood resource and an increasing dependency on imported wood and wood products demonstrates the need in Tonga for a strong reforestation policy towards providing local timber needs and reducing overall loss of foreign exchange.

'Eua is the island best suited for commercial plantation forestry development as it still has some land which has not been divided into 'api. The government's main reforestation effort is focussed on 'Eua, where, with the long term commitment of the New Zealand government, some 335 ha of exotic forest plantation have been established since the first small trial planting in 1958. Future plantation establishment is expected to continue at a rate of about 80 ha per year, providing land is made available.

The earlier planting on 'Eua were made on poor soils or wind-exposed areas and subsequently have poor growth. Planting on better soil show promise but will not commence to reach commercial rotation age until around the year 2000. The utilitarian species planted are (*Pinus caribaea var hondurensis*, *Cupressus* lusitanica and *Eucalyptus saligna*); plus a significant area of the very high-value timber species *Toona* australis (Australian red cedar).

While high-value timber species like Australian red cedar have an assured market and economically viable production could reasonably be expected on the better 'Eua soils, the utilitarian timbers will face strong competition on the main Tongatapu market with sawn timber imports from New Zealand, Fiji and Australia and commercial viability of these species is less certain.

Small scale reforestation activity distant from the main population centres therefore would seem justified from an economic viewpoint where the target species will provide high value wood for an export market, and for local value-added treatment prior to export; and where the species serve a specific conservation purpose, such as soil protection, site rehabilitation, wind shelter belts, nutrient pumps, etc.

Nuku'alofa itself would appear to be an under-utilised location for tree establishment in the urban environment, especially along roads, and around the boundary of allotments. The MAF produces seedlings for planting by private citizens of species of cultural, food or ornamental value, and thousands of them are distributed by the Environment Planning Section each year during Environmental Awareness Week. However it is reported that the number of seedlings which survive is low due to damage from domestic animals and lack of care.

Seedlings provided could be of suitable firewood species, or multi-purpose species which, for example, would supply both fruit and valuable sawn timber. Multi-purpose species are in fact distributed from a number of MAF nurseries throughout the Kingdom, but Forestry Division's greater involvement would seem desirable. Urban forestry programs in other countries could serve as a useful model for supplying a greater proportion of Tonga's timber needs in the cheapest way, while at the same time providing other community benefits, and an overseas study of these programs, particularly in China, is advocated.

Botanical gardens are living museums. It is usual for such Botanical Gardens to be established and maintained by the forestry profession. A small garden of about 1.5 acres has been established in Nuku'alofa,

but a significantly larger area will be required if the Botanical Garden is to contain representatives of all vegetation of the Kingdom of commercial, cultural or ornamental significance. More attention particularly needs to be focussed on plants valued in traditional medicine and for other cultural purposes which could be a reservoir of future economic benefit.

4. Water

The main problems concerning water supply in the Kingdom are quantity and quality of groundwater supplies; and the appropriate collection and storage of rainwater.

Water quality

The principal cause for concern with groundwater is the contamination of the water supplies from saltwater intrusion, agricultural chemicals or other noxious or hazardous wastes, and, particularly with groundwater on the low atolls, by improper disposal of human and animal wastes. Most Pacific Island Countries have reported human waste disposal problems.

On low atolls, dissolved wastes are not filtered out by the soil because of the low clay content. The low elevation and shallow water table ensure that pollution rapidly reaches the groundwater. In some low lying communities where groundwater is used as the drinking water source, health problems such as diarrhoea and hepatitis are quite common, with even occasional outbreaks of typhoid.

Limestone areas may also suffer health problems due to a tendency to iodine deficiency leading to goitre. Earlier public health programs that provided injections and use of iodised salt have faltered and this environmental health problem has reappeared.

Localised problems with pesticides and herbicides have occurred but primarily through the incautious disposal of excess biocides close or directly into the water. Other chemical use such as fertiliser is limited and not considered a major problem to date, but with the increasing tendency to intensive horticultural production, this potential source of pollution will require careful monitoring.

Groundwater supply

In some outer islands, wells have been dug in the wrong places and rates of drawdown in excess of the recharge with the result that some are now quite brackish, and some boreholes abandoned because of unacceptable high salinity.

Tongatapu is fortunate in having two known groundwater fields with available water volumes believed adequate for existing community and some horticultural uses. Tonga's groundwater is currently being studied as part of the development of a Water Master Plan for the nation for the next 20 years.

Rainwater storage

Historically, rainwater catchments, tanks and cisterns provided drinking water for many areas of the Pacific, including large areas of rural Australia. This is practical and, in the circumstances, eminently sensible practice not only in terms of water quantity, but also from the viewpoint of water quality where there is groundwater pollution.

Expatriate engineers in Tonga have placed emphasis in the past on reticulated water supplies even in small communities such as Pangai in the Ha'apai Group, this could lead on to emphasis on household and community (e.g. churches, meeting halls) rainwater catchments and water storages to supply drinking water. There have been several programs of technical assistance in the Kingdom for the construction of catchments and storages, and the national emphasis is to be strengthened, and hence expenditure, on such self-sufficiency measures.

It has been found that some engineers offering their services in the Pacific have had little experience with rainwater catchment systems. In some Tongan villages on the outer islands where good quality drinking water is at a premium, it is still by no means uncommon to see large roofed areas which are not used to collect rainwater.

5. Marine ecosystems

Monitoring

It is difficult to avoid some conjecture on sustainable catch levels because there has been no regular monitoring of reef condition or of catches on the important nearshore subsistence fisheries. Following the design of a cost-effective data acquisition system for the assessment and management of shell fisheries of Tongatapu, and a sampling scheme for monitoring nearshore reef fisheries, the Fisheries Department is now engaged in monitoring inshore reef fisheries. But more data are required, particularly on invertebrates and the biological condition of the reefs.

As a fundamental tool for a monitoring program, new high resolution colour aerial photography to permit temporal and spatial comparisons of coral reef, sea grass beds and of mangroves. The most recent available complete photographic coverage of Tonga was flown in 1968. It is understood that new air photography will soon be flown under an Australian aid program.

Aquaculture

As with many other Pacific nations, Tonga has explored a number of prospects for aquaculture both to augment local protein needs and for export, and this interest remains, as witnessed by Tonga's keen participation in the regional ACIAR project on Giant Clam cultivation. While the field of possible organisms which could be amenable to aquaculture is enormous, few have assured market prospects.

6. Energy

Alternative energy sources

In turning to alternative sources of energy, there has been some advocacy in Tonga of the use of the incineration of imported waste to generate electricity and this has caused vigorous debate. Energy can certainly be derived from waste incineration, but any proposals must be subjected to the most rigorous scientific scrutiny to assess all possible benefits and disbenefits.

There are other energy sources which have far less potential for environmental pollution and these are currently quite underused throughout much of the Pacific, and the Kingdom of Tonga is no exception. The important alternative energy sources for the islands are solar, wind, tidal movement and biomass.

Solar energy in combination with diesel generation is proving a viable option in remote Australian areas for supply electricity with significant diesel savings over normal stand-alone diesel generators. On its own, solar energy is used to provide lighting, water pumping, air conditioning, and hot water, at a price. Of these, the most practically useful ad affordable at this stage are simple hot water systems and these are proving attractive to the cooler and more affluent urban centres like Nuku'alofa.

Windmills have long been used in the region for water pumping and D.C. electricity generation for many years, although few of the latter are seen these days.

Recent new Australian designs for biomass combustion for steam generation, and for regulated steam engines, make small scale electricity generation for island communities a real and relatively cheap prospect compared with normal generation with imported diesel. Providing,of course, that a continuous supply of suitable biomass is assured and labour is available and willing to harvest the fuel, feed the firebox and maintain

equipment.

Ethanol or methanol production from biomass is not a real option Tonga (or for the Pacific as a whole), the literature indicating that the real cost to the community of fuel alcohol is considerably higher than that of imported diesel when the energy cost of producing the biomass in the first place is taken into account.

The reality is that most communities now equipped with diesel generators are not going to abandon them. It would be quite wasteful of existing capital investment to suggest such a course. So these generators will serve out their useful life. Thus the more practical option for electricity generation at this point in time would be to supplement diesel generation with solar cell systems and accumulator batteries, reducing the rate of diesel consumption.

The main renewable source of calorific energy available in the Pacific is biomass, particularly firewood and coconut shell/husks, for cooking and water heating. And even in Nuku'alofa where many homes have gas or kerosene cookers, firewood is always in demand for the at least once weekly traditional cooking in a ground oven by most households.

In Nuku'alofa, firewood is already in short supply. Considerable quantities of wood of suitable species are required for cooking, and particularly for 'umu. The wood sold in the Nuku'alofa market at T$5 per bundle comes mostly from 'Eua. Increased attention to promoting the planting of fast growing fuelwood species in Tongatapu, perhaps as a cash crop which also serves as a windbreak around cultivated areas, would seem desirable. Eucalypt coppice-wood species may be worth closer examination for this purpose as the rotation age is short (5-8years) and a stool (coppice stump) will continue to supply firewood for many years with proper management.

III. RESPONSES TO DEVELOPMENT/ENVIRONMENT ISSUES

DPVI has, as a national objective, the continued protection and management of natural resources for sustainable development, and in accord with that objective and the Government aims to implement policies to prevent depletion of the Kingdom's natural resources. At the same time, the over-riding development objective is that of achieving sustainable economic growth, and recognising that this objective may conflict, on occasion, with other objectives, such as the protection of natural resources.

Economic growth is seen as a precondition for other economic objectives, and in the pursuit of this imperative, some damage to the environment will be unavoidable; the aim would be to ensure that there is no irreversible damage which would of itself limit the prospect of long-term economic sustainability which is intimately bound to the Kingdom's natural environment.

Prime concerns of Government are:

- land management, including coastal zone management to minimise pollution or siltation of reefs and lagoons;
- marine resource management, particularly overfishing in coastal areas, and over exploitation of the black coral on which the jewel trade is based;
- climatic change and sea level rise, particularly with respect to low-lying areas of the main islands and also of the atolls; and
- the maintenance of the remnant biological diversity, particularly the protection of rare bird species.

A. Government Policies, Legislation and Other Developments

1. Environmental management planning

The GOT asked ESCAP for assistance in 1987 with the preparation of an environmental management plan for the Kingdom. At ESCAP's request, the Government formed IDEC, an Interdepartmental Environment Committee to guide EMP preparation, and coordinate the compilation and review process.

The IDEC comprises the Ministries of Lands, Surveys and Natural Resources; Health; Foreign Affairs and Defence; Agriculture and Forestry; Fisheries; Works; Labour, Commerce and Industries; Central Planning; and the Tonga Visitors Bureau. It is recommended that the Ministry of Police Department (which is charged with the responsibility of policing the environmental provisions of Acts and Regulations) and the Ministry of Education should be represented in the IDEC.

The IDEC/ESCAP Symposium held over August 27-29, 1990, was the culmination of IDEC's prime task. The EMP produced is a valuable first step in the process of moving to implementable environment management strategies and programs. The Symposium recommended to Cabinet that IDEC should be retained to supervise the implementation of the EMP.

2. Environmental impact assessment (EIA)

The EIA policy which has applied since 1985 is for the Central Planning Department to pass on all development proposals to the MLSNR which then conducts its assessment of whether a proposal will require EIA. Where the MLSNR's Environmental Planning Section has the capacity, or can call on expertise available locally, the EIA is conducted in-house.

Otherwise, a request is made to SPREP for technical assistance with the performance of the EIA. SPREP would then decide whether to use its own technical staff or to engage external consultants. A draft report would be circulated to relevant government authorities for comment and subsequently a final impact statement prepared for submission to Cabinet. There is no public participation in the process.

In practice, there has been little call for SPREP's assistance for EIA and few in-house EIA have been carried out on development proposals. While Government several years ago decided that all major new projects would be subject to EIA, this has been very difficult to put into practice because the policy was not backed by legislation.

Legislation for a Land Use, Natural Resource and Environment Planning Act has been drafted which would include EIA procedures. Until such legislation in enacted, the Division of Land and Planning of MLSNR has recommended adoption of an EIA policy.

3. Legislation

There is a large body of legislation containing provisions of environmental importance, some going back more than 50 years, such as the Birds and Fish Preservation Act, 1934. Legislation of greater environmental import includes:

Parks and Reserves Act: establishment and management of national parks and reserves, primarily with the goal of preserving wildlife and forest species.

Forests Act, 1961: provides for the establishment and management of forest reserves. (The legal significance of a forest reserve is not clear in terms of trees taking first priority in the event of a conflict of interest.)

Birds and Fish Preservation Act: provides for protected areas and provides for declaration of complete protection or closed seasons for specified species; prohibits the cutting or removal of mangroves in any area.

Fisheries Act, 1990 : this legislation has just been enacted; it will support a sustained development approach to the Kingdom's fisheries. The Bill requires the development and application of what amounts to a corporate plan for the national fisheries; the Bill also contains special environmental provisions governing fishing method, including use of poisons and explosives. (The existing Fisheries Regulation Act contains similar environmental provisions.)

Whaling Industry Act, 1935: prohibits the hunting of baleen whales.

The following legislation contains environmental provisions:

Land Act: controls land use; while s22 of the Land (Timber Cutting) Act regulates cutting and taking of trees, removal of sand and quarrying.

Public Health Act: covers water supply, tanks and wells, health dangers, infectious disease control, food inspections, sanitary facilities, building regulations, litter, inspections of public facilities.

Minerals Act, 1949: Sets conditions for permits for mineral exploration and mining for protection and restoration of forest areas.

Forest Produce Regulations, 1979: require an export licence for forest produce except for value added product.

Pesticides Act, 1975/1981: regulates the registration, manufacture, sale and use of pesticides. As at 1988, no pesticides had been registered. While labels on many pesticides are now printed in Tongan, the EMP reports "There are no standards or regulations covering the kinds of pesticides which are allowed to be imported and used in Tonga and private individuals and companies can and do import whatever they want. There are no restrictions on where pesticides of different toxicities may be used ..[and] ..no..regulation of disposal of empty containers...".

Plant Quarantine Act, 1981: provides control for importation of plants and their internal movement within Tonga to protect agriculture from the introduction and/or spread of exotic plant pests and diseases.

Noxious Weeds Act, 1903: provides for the eradication of plants harmful to agriculture.

Territorial Sea and Exclusive Economic Zone Act, 1978:includes provisions for the protection and preservation of the marine environment of the territorial sea, including the specification of the total allowable catch.

Garbage Act: garbage control and refuse dumping.

Customs and Excise Act, 1983: provides coral protection.

Polynesian Heritage Trust, 1984: cultural preservation.

Preservation of Objects of Archaeological Interests Act, 1969:
Protects historic sites from excavation without license and removal of heirlooms from the Kingdom.

There is also a series of Town Regulations, which cover such aspects as town cleanliness, planting, cutting of plants, pig and goat control, and litter.

4. Environment conventions

Conventions impose certain obligations upon contracting parties. There are a number of international and regional conventions of environmental import in the South Pacific. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the South Pacific Nuclear Free Zone Treaty (Rarotonga Treaty), and the Law of the Sea Convention are widely regarded as three crucial international documents for the Pacific.

Two important conventions are now being drafted. The first arises out of the Brundtland Commission which called for the UN General Assembly to prepare a Convention on Environmental Protection and Sustainable Development. The IUCN has also identified a series of actions to develop legal mechanisms for sustainable development, including the adoption of a Convention on Biological Diversity. UNEP is drafting that proposed Convention with the intention of having it available for signature at the UN Conference on Environment and Development in Brazil in 1992, the conference for which this National Report is being prepared.

The two major regional environmental conventions are the Convention on the Conservation of Nature in the South Pacific (Apia Convention); and the Convention for the Protection of the Natural Resources and Environment of the South Pacific (SPREP Convention), which has two protocols.

Both of these regional Conventions are now in force.

The Apia Convention was first circulated in 1975 and required ratification by four countries. Until 1989, only Cook Islands had acceded to the Convention but by late 1990 five countries had acceded to or ratified the Convention. These are Australia, Cook Islands, Fiji, France, and Western Samoa.

The SPREP Convention required the accession/ratification of ten countries before it entered into force. The tenth country ratified in July 1990. The 10 signatories are Australia, Cook Islands, Federated States of Micronesia, Fiji, France, Marshall Islands, New Zealand, Papua New Guinea, Solomon Islands and Western Samoa.

5. National parks and reserves policy

The Tongan response to the need for protection of marine and terrestrial areas of special environmental or cultural concern has been the declaration of nine protected areas recognised by UNDP/IUCN, and the designation of 17 Protected or Traditional Areas of Respect that are under protection basically because of the "Preservation of objects of Archaeological Interests Act of 1969."

The nine protected areas comprise five National Marine Parks and Reserves, two National Historic Parks, and two other protected areas.

IUCN PROTECTED AREAS

Name	Area (ha)	Year
1. Fanga'uta Lagoon and	2830	1974
2. angakakau Lagoon		
3. Ha'amonga Trilithon	23	1972
4. Ha'atafu Beach Reserve	8.4	1979
5. Hakaumana'o Reef Reserve	126	1979
6. Malinoa Island Park	73	1979
7. Monuafa Island Park	33	1979
8. Muihopoponga (Niutoua) Beaches	2 km long	1972
9. Pangaimotu Reef Reserve	49	1979

The 17 Other Protected/Traditional Areas of Respect are:

Captain Cook's Landing Place; Fa'onelua Gardens (Nuku'alofa); Futu Ko Vuna (Lapaha); Giant Clam Sanctuaries (Nuku'alofa, 1986 and Vava'u, 1988); Hala Paini; Haveluliku; Haveluloto Foreshore; Hule Fortification; Mala'e 'A Tuli and Forest Reserve; 'OtuLangi; Ha'atafu Missionary Landing Site; Mt Zion (Kolomotu'a); Pangai si'i; Site of First Sacrament; Va'omapa Terrestrial Park; Vuna Road and Norfolk Pine Tree Reserve.

The list of recognised parks and reserves reflects past emphasis on marine parks. At present there are no official national terrestrial parks or reserves in the Kingdom although there has been a proposal under consideration, for some years, for the establishment of a National Park in the south-east of 'Eua.

Nine additional areas have been proposed for formal protection, including the main terrestrial areas of particular interest. These are:

NAME

1. 'Eua Terrestrial Park (4180ha)
2. Volcanic Island Reserves (to protect bio-diversity in Kao, Late, Niuafo'ou and Tofua Islands)
3. 'Ata Island
4. Coral Gardens (Vava'u)
5. Kanokupolu Historic Park
6. Langi Nu'a Historic Park
7. Mt Talau Terrestrial Park (Vava'u)
8. Puono Historic Park
9. Swallow's Cave (Vava'u)

B. Institutional Developments

Under the current National Development Plan, environmental administration is vested with the Ministry of Lands, Surveys and Natural Resources. Within the MLSNR, the government's policies are implemented by an Environment Planning Section which currently has six trained personnel with environmental qualifications while a further three are undertaking training in Australia and New Zealand. One officer is expected to be admitted to a Ph.D. in Environmental Sciences in 1991. The EPS's field programs are supported by 10 Parks and Reserves workers.

The EPS has an urgent need for additional trained staff, at least on a temporary basis until the officers currently being trained overseas have returned to duty. However, immediate consideration of institutional strengthening may be restrained by the process of the ECG's review of the recommendations of the EMP, including those for strengthening environmental administration.

C. Specific Programs and Projects

Because of the number of bilateral and multilateral agencies offering assistance to Tonga for its further development, no list of programs can ever be complete or up to date. The brief outline of projects of considered environmental significance in this section can represent only a snapshot in time.

1. External funding

The main sources of bilateral assistance are Australia, New Zealand, Japan and the European Community.

- Australian assistance has concentrated in recent years on the infrastructure sector (such as ports, airport, telecommunications), to social services (water supply, sanitation and education) and to the agriculture and fisheries productive sectors.

- New Zealand's program has focussed on the agriculture sector, including reforestation on 'Eua, on public utilities and on education.

- Japan has concentrated on infrastructure (seawall, cultural centre, airport terminal), on the fisheries sector, and on health and education sectors.

- The EC has assisted with regional planning (Vava'u Group) and a wide range of technical assistance.

- Germany and France, in particular, and also United Kingdom, Canada, USA and Norway all provide assistance, mostly through technical advice.

Many multilateral organisations, particularly within the UN framework, provide technical advisers and other assistance. And agencies such as the Asian Development Bank, the World Bank, the European Investment Bank and the International Fund for Agriculture Development provide support in the form of concessional loans, or by direct technical assistance.

2. Environmentally relevant projects

Water: There are two water projects underway. The first is a 12 month study to develop a Water Supply Master Plan, which includes the preparation of demand projection by user categories through to the year 2010.

The second is institutional strengthening through the establishment of a Water Resources Unit within the Ministry of Lands, Survey and Natural Resources, and the technical assistance of a hydrogeologist to assess and monitor water resources. Aquifer identification has been completed on Tongatapu, and Ha'apai. Both are funded by Australia.

Technical assistance and training was also recently provided under a now completed Israel/UNDP initiative.

Following completion of the Water Supply Master Plan, the Asian Development Bank has pipelined a Water Supply Development Project for well field and reservoir development firstly on Tongatapu, with upgrading of reticulation in Nuku'alofa; and then on 'Eua; there is also

provision for well-field, reservoir, and pipeline development on Ha'apai and Vava'u as a possible second phase to the project.

Energy: A number of energy proposals have been submitted for inclusion in the estimates. These include small solar lighting projects in Vava'u, Ha'apai and Niuafa'ou; and technical assistance for energy sector institutional strengthening from UNDP.

And negotiations have progressed on the construction of a major Wave Energy Power Station.

National Parks:

Proposed for inclusion in the estimates with ADB/SPREP funding is the preparation of detailed plans for the establishment and management of national parks on 'Eua and Vava'u. Australia is providing technical assistance and infrastructure development also for new National Park establishment.

Aid from Australia and other sources is anticipated for a program of preservation of historical reserves, monuments and the development of trails through areas of biological or cultural significance.

Lagoons: An environmental management plan is being prepared for the main lagoon on which the Kingdom's capital is situated (Fanga'uta Lagoon); and of the smaller Sopu and Puke lagoons on the north-west boundary of Nuku'alofa, and other low-lying areas of Tongatapu. Colour aerial photography has been flown of Fanga'uta Lagoon which illustrates well the existing serious pollution problems there.

Roads: As part of the Fanga'uta Lagoon project, hydraulic studies will also examine the effects of a possible causeway bridge across to Nukuleka. Causeway studies will also be undertaken in Ha'apai, and these should include open causeways of the Hornibrook Highway type, an internationally acclaimed engineering feat in its day which caused little restriction of tidal movement.

Road drainage and siltation studies are planned for Vava'u.

Sanitation: A project of the National Sanitation Program is underway to provide proper sewage disposal for residents of low-lying areas, with local residents paying 20% of the cost as well as providing labour.

Global climate change:

Tonga is participating in an Australian funded regional program for monitoring sea-level in relation to global warming. The Kingdom will be increasingly concerned about the likely consequences of the global climatic change, particularly for low lying areas of the main islands, but this concern has yet to be translated into town planning modification.

Resource mapping:-seabed:

SOPAC has begun the long task of mapping the seabed resources of the region.

A major aerial photography exercise will soon be mounted with Australian assistance which will provide the basis for upgrading the resource information base and is an essential first step in the development of GIS for Tonga and for all land-based planning. The currently available airphotos are so dated as to have little value for cadastral information or land use typing. The purchase and analysis of satellite imagery is also programmed.

A separate but related project aims to upgrade land registration, recording, mapping and information storage system, including the digitising of geographic and cadastral information to provide a computer mapping capability.

Construction:

New Zealand has provided assistance with an investigation into alternative sources of construction materials, and together with local funding, renewed field research is planned for sand deposits to reduce the impact on beaches through sand-mining. An offshore sand dredging project has also been proposed and the environmental significance or risks attached to such activity compared with quarry operation.

Urban planning:

The Popua Master Plan for a new Small Industries Centre is being designed to minimise any direct run-off into the Fanga'uta Lagoon and the containment of human wastes with individual septic systems. The first phase of this plan has been completed with Australian aid. The plan is directed at light industry establishment in the area and thus should present no further water pollution hazard nor polluted air to blow over Nuku'alofa.

The garbage dump at Popua is to be re-located to a proposed new site at Muifonua. Dump design would make provision for proper separation and management of waste solids and of hazardous wastes. Bunding and other works are envisaged to develop the site in an environmentally sound manner.

Nuku'alofa and Environs Urban Development Plan - a major study is planned which will permit the development of new coordinated development plans for the capital, and setting the framework for better handling of the rapid urban expansion through in-migration from outer islands.

A Sopu-Hihifo Master Plan will be developed as an immediate need, but with the plan dovetailing into the broader Nuku'alofa and Environs Urban Development Plan. This plan would particularly address the need for drainage works and the reopening of the Sopu and Puke lagoons to the sea.

Regional planning:

Ha'apai Group:

Project implementation following the preparation of an Australian funded integrated development plan for the Ha'apai Group is proceeding, including development of harbours and improved navigation aids.

Vava'u Group:

Project implementation is imminent for the EC funded integrated development plan for Vava'u Group.

The conduct of this regional planning arose from a perceived need to co-ordinate development planning for the Kingdom, including the need to give proper recognition to current environmental problems, and those foreseeable as a consequence of planned development activity.

Agriculture: A joint World Bank/ADB Agriculture Sector Review was undertaken in 1990 and, as endorsed by MAF, identifies sustainable farming systems as the required focus rather than large-scale, monoculture horticultural crops. Cash cropping should be developed to take advantage of the traditional agroforestry production systems.

Agroforestry Development Project: A special long-term line of credit has been proposed for agriculture/tree crops development within the agro-forestry system; construction of produce and cool storage facilities; upgrading of MAFF extension facilities; together with a number of technical assistance grants to strengthen institutional capacity and advance commercialisation or privatisation of some government agricultural activities.

MAF has also proposed for inclusion in the estimates diversified fruit tree development, spice development and integrated pest control, all of which fit within the agroforestry concept.

Reforestation: New Zealand continues project support and is providing assistance for an annual reforestation target of 80 ha on 'Eua. Also on 'Eua, the MLSNR and MAF have proposed to develop a Forest Park to help preserve some remnant examples of natural forests.

MLSNR and MAF also propose to enhance its fuelwood planting promotion campaigns both on Tongatapu and on 'Eua.

Cultural: With tripartite funding from the GOT, NZ Government and the TCSP, a Handicrafts Planting Program is proposed which will help maintain the resource of tree and shrub species valued for the production of traditional handicraft.

Tourism: A National Tourism Plan is proposed to be developed with assistance of the ADB.

Environment -General

Tonga is one of five countries of the region participating in the Regional Environment Technical Assistance program (funded by the Asian Development Bank and being executed by SPREP) which will develop environment management strategies and recommend high priority actions which should be undertaken, as well as providing in-country short course and on-the-job training in environmental fields, including EIA.

An Environmental Education Program on the Budget Estimates for the production of educational materials to promote environmental awareness and understanding has been submitted for estimate inclusion.

D. Training, Education and Public Awareness

1. Public awareness

The EPS recognises that there is low level awareness in the community on significant environmental issues of direct concern to Tonga. In tackling this problem, the EPS has put in place a number of programs which seek to foster environmentally sound attitudes towards social and economic development by informing the community on issues and soliciting public support for environmental action.

The major annual activity which attracts most public attention, at all levels of society and ages, is the National Environmental Awareness Week, which is held in the first week of June each year to coincide with World Environment Day on 5 June. The World Environment Day theme is adopted for local awareness activity throughout the week.

Radio programs are conducted at two levels: a three times daily radio spot in Tongan and English on an environmental theme in community news; and twice monthly radio sessions, usually lasting for 15 minutes. The latter can be interviews, panel discussions, or talks, and leavened by environmental songs and news snippets.

Tongan language articles are prepared occasionally for the newspapers, but frequency is constrained by the cost of paying for the insertion of the news article.

School visits are made on the average of four times a month, on the request of teachers. These are quite popular and can cover a wide range of activities, with an emphasis on doing rather than talking.

And the EPS has a constant program of involvement with NGOs and, in particular, with community groups. These include women's church groups, Young Men's/Young Women's Christian Association, the National Youth Group, Scouts and Girl Guides, Red Cross; while on the regional or international NGO front with FSPI, Earth Quiet, Earth Watch, SPACHEE, and Greenpeace. EPS representatives also take opportunities such as addressing service organisations, such as Rotary.

2. Public participation

There is no formal mechanism for public participation. Representatives of community organisations and the churches may be invited as observers to special meetings. But the EIA process itself does not involve public discussion of environmental issues, proposed safeguards, or solutions to problems. Where real achievement in improving public attitudes to environmental problems is going to depend heavily on public commitment, the lack of public participation is of concern.

3. Education and training

Environmental aspects are included as components of standard subjects of primary and high school curricula, as well as being a subject of study in its own right -Environmental Science for classes 1-6 in the Primary Schools; Tongan Studies and General Science for Forms 1-5, and more comprehensively in Geography, Biology and Chemistry for Forms 3-6 in the Secondary Schools. Environmental issues are also treated at the tertiary level within the agricultural science and biology diplomas.

Apart from the education system, all ministries with responsibility for the natural, social and built environment (which embraces just about everything) have a teaching/extension role. The two ministries of central concern, MAF and MLSNR, do undertake extension activities, but more emphasis is required, with the production of brochures, posters, pamphlets and the like, when a more interactive approach is needed of one-to-one and group advisory activity with growers and fishermen.

IV. PLANNING FOR SUSTAINABLE DEVELOPMENT

A. Prioritising Sustainability Issues

The following are considered the main issues to be addressed if sustainable development is to be achieved:

1. Population and human settlement planning
2. Land management-rural development and agriculture
3. Natural resources and energy conservation
4. Investment in industry, trade, and tourism, and development of infrastructure

1. Population and human settlement planning

The major environmental problems seen in Tonga appear to be focussed on the main urban centres. The problems seem closely correlated to pressure arising from growth and urbanisation of the population, within a severe land constraint. This constraint is one of a limited availability of additional land suitable for urban 'api settlement which is not environmentally sensitive.

This observation appears most true of the national capital, Nuku'alofa, and its environs.

The problems of coastal management and over-exploitation of marine resources, which also appear most pronounced within the immediate environs of the urban centres, are exacerbated by an inadequate attention in the past to urban planning and management. And the lack of urban planning must be seen within the context of a sparse framework of national land use planning and management. [In small island environments such as the Kingdom of Tonga, all land, from the highest topographical point to the outer edge of the fringing reef is technically considered to be 'coastal'.]

In Nuku'alofa, rapid population growth and inadequate land planning have led to low-lying areas adjacent to urban centre being used for housing. In the worst areas, the water table is at or above the surface in the wet season; there is no drainage; sanitation is severely constrained and health problems are of considerable concern.

Even if we assume the net population growth rate for the Kingdom over the last decade, together with internal migration from outer islands to Tongatapu does not increase, the urbanisation problem on Tongatapu will escalate rapidly. Should the current external migration rate of 1.8% be curbed for any reason, then the environmental problems associated with rapid urbanisation will be magnified. In that regard it should be noted that New Zealand has recently applied curbs on immigration; but the possible effect of these new policies on reducing Tonga's emigration rate may be at least countered by increased migration to the mainland USA where many Tongans have relatives.

An increasing trend to urbanisation will be reinforced further by the ever improving educational level, and by rising expectations for the higher living standards which are perceived by some to be associated with an urban existence.

Therefore, a high priority for the Kingdom would be to ensure urban and social planning takes current and predicted impacts of urbanisation fully into account.

2. Land management -rural development and agriculture

It would appear that only one third of eligible Tongan males has registered land allotments. Most arable land has already been allocated and there has been a tendency to subdivide allotments. There is also a tendency to register environmentally sensitive land, or land that is not appropriate for cultivation or settlement. And as the population grows, scarce arable land resources are taken from agricultural production for urban settlement.

Mangrove areas near Nuku'alofa have been cleared despite scientific evidence of the vital role of this ecosystem in marine ecology.

A second major concern, therefore, is for the institution of comprehensive, land use planning at the national level, and for coordinated land management activity. This is particularly so for Tongatapu and the coastal and lagoon foreshore in the Greater Nuku'alofa area from the trade, tourism and human settlement viewpoints. Planning for urban development should proceed as an integral part of broader national landuse planning.

The social consequences which may arise from the application of any landuse plan should ever be upmost in the planners' minds, particularly so for that segment of the population with a low level of disposal income. And forms of rural development fostered by government should accommodate the smallholder subsistence grower, not only the larger commercial producer.

3. Natural resources and energy conservation

Traditional land practices served to sustain the productivity of land and marine resources. The avid application now of western technology, coupled with limited public understanding of the inherent value of the resources, or of the interaction of one resource component with another, sets the scene for ecologically

unsustainable resource use.

The vital 'non-living', natural resources are soil, water, air and energy. The air is not polluted. The efficient use of groundwater must be ensured and the collection and storage of rainwater fostered. This leads to the need for an integrated approach to water management, including the prevention and control of pollution of groundwater. For energy, the need is for the development of clean and renewable energy sources, including tidal, wind and solar. Current tidal energy studies
merit full support of government.

It is in the area of living resources though that considerable concern is expressed. Little of what may be considered Tonga's original vegetation remains and that remnant is under attack from gardening wherever the forest is accessible. A number of rare species of birds are known to exist still in the Kingdom; some have disappeared already from Tongatapu and are found only in remote locations. Protection action is required for these species, and, for those rare birds in danger of extinction, breeding programs conducted to restock populations. The excellent work of the Brehm Foundation of Germany in this regard must be noted here.

In the marine world, the good work of the Fisheries Department in breeding up stocks of giant clam to restock areas of the Kingdom from which the local species has now almost disappeared is also most laudable. Urgent attention has been called to the need for preservation of the diminishing numbers of sea turtles and institution of breeding programs.
The need to establish national parks and reserves is now considered critical, both marine and terrestrial, but particularly the latter because there are already a number of marine reserves, but no terrestrial reserves. If action is not taken on the national park issue, there will shortly be no need for them, as there will be little left to preserve, the remnant forest resource contracting to only those areas inaccessible to man.

Thus high priority is attached to the institution of a series of measures which aim to conserve or preserve the living and non-living resource base of the nation and to foster the efficient use of energy. Such measures include direct resource conservation action, and supporting action in the areas of legislation, institutional strengthening, pricing policy, reserves policy, and public education programs.

4. Trade, industry and development investment

The capacity for the Kingdom to apply its own financial resources to environmental issues in the mid to long-term will largely depend on investment in industry, trade, and tourism, and the development of infrastructure which supports them. That is, on the nation's economic health.

National trade and investment policies must be compatible with sustainable development. Major project proposals must therefore be assessed from the viewpoint of both short and long-term impact on the sustainability of the resource base. This, in essence, is Environmental Impact Assessment. And it is very much in the Kingdom's own interests to insist on, and where necessary assist, the conduct of EIA on significant development submissions by the proponents of the development.

The government's role would be to assess such EIA and, where considered necessary, require additional studies to be carried out, or call for a additional independent, EIA appraisals.

Tourism can reasonably be expected to become one of Tonga's largest industries, if not the dominant industry. But the promotion of tourism should be clearly made in the context of Tongan concern to protect cultural values and traditions from the adverse effects of that industry seen in some other Pacific destinations. Before tourism can take off in a large way, though, there is much infrastructure development still required, particularly of hotels and restaurants of international standard, but also of attractive, varied, tourist activities. And even greater effort is needed for the training of Tongans to service the tourist trade.

Again, the national concern is to ensure compatibility between tourism projects and conservation values, avoiding any diminution in the value of those special features of Tonga which tend to attract tourists in the

first place.

B. Constraints to the Sustainable Use of Resources and Environment

1. Information on population issues

Population issues and national development and environmental policies are inseparable. But the information base needed for rational policy development is quite inadequate. In particular, there is very limited information on population issues in relation to sustainable development. Such information is vital for effective planning, both in the rural and urban setting.

The main source of information on population is the census conducted each decade, the last being in 1986. This is a snapshot in time. But with Tongan society adjusting rapidly, there is a need for more frequent mini-surveys to study particular facets of population attitudes and practices. Such survey would include agricultural and marine based activity, firewood consumption trends, urban and rural gardening activity, etc., not all in the one questionnaire, but in repeated annual mini-questionnaires of a statistically valid sample of the population.

2. Land use planning capacity

There is both limited institutional capacity and commitment for undertaking rigorous, national, land use planning exercises which allocate or zone land according to its suitability and capability.

Urban planning is part of that national planning need, and in the absence of the latter, has the risk of being ad hoc in the long term. Because the reshaping of society's use of land is disruptive socially, repeated changes in land use policy for any parcel of land are most undesirable. Thus, national land use planning should be the first target, subsequently undertaking urban planning within the context of the defined national land use zoning.

3. Agricultural use of available land

Only about 37% of the land is actually cultivated. While the Land Act provides for penalties for unused or misused land, sanctions are not commonly applied. Because of the shortage of unallocated rural land, the size of tax 'api used for intensive horticulture may need to be reduced in area.

4. Land tenure security

Most farmers find it very expensive to secure leases and to obtain compensation for their investments. This is a constraint on the effective utilisation of agricultural land. With insecure, short-term tenure, farmers are discouraged from practices that will maintain the productivity of the land or protect biological values.

A Royal Land Commission was established in 1986 to review the existing Land Act. However, its findings and recommendations have been deferred. It has become inescapable to avoid the question of reappraisal of the land tenure system enshrined in the constitution. Land reform pertaining to the land tenure system should be explored as a step towards achieving equitable access to natural resources, and providing security of tenure.

5. Pricing of use of natural resources

The pricing level of natural resources and energy should be commensurate with the level of use or resource

impact. However, there is no pricing mechanism for encouraging resource and energy conservation. Ground water use and electricity consumption are the two notable examples. For these, consideration of the introduction of the 'user pays principle' should no longer be delayed.

6. Monitoring capacity for agricultural chemicals

The concern for the environment, and for the health of the consumer, arising from the improper use of agricultural chemicals is common to the Ministry of Agriculture and Forestry, and to the Ministry of Health. Both have expressed the need for mutual co-operation, in a coordinated attack on the problem.

Both organisations are constrained by inadequate laboratory facilities and insufficient, trained staff to provide the essential monitoring service for toxicity and persistency of agricultural chemicals, hormones and veterinary drugs.

While some monitoring activity is undertaken using NZ laboratories, such external analysis is necessarily restricted to those residues or contaminants not affected by extended storage. For example, this excludes some analyses for pesticides which have to be done within 24 hours to obtain valid results; the frequency of high transportation costs within the Kingdom and NZ precludes this prospect.

A division of effort between the two Ministries which is suggested by their functional responsibilities would be for the Public Health Section of the Department of Health to test for drugs, hormones and chemical residues in food and water; while the Soil Chemistry Section of the MAF conducts toxicity and persistency tests of agricultural chemicals in soils and plants. The laboratories of both organisations need considerable upgrading in order to handle such chemical monitoring.

Institutional strengthening will be required for each organisation in the recruitment and training of both field and laboratory staff. In parallel with this, attention to the following would be essential:

- public awareness and education programs to foster the safe use and handling of agricultural chemicals;
- revised legislation which addresses the evaluation, importation, storage, safe use, and disposal of all hazardous chemicals, including pesticides.

7. Access to marine resources

With new technology and destructive practices, coupled with a traditional common use of marine resources, fishermen have over-exploited resources of fish, crustaceans and invertebrates within the inshore-nearshore reef areas. The traditional free access by all to any marine resource is a constraint to conservation action. The curtailment of such traditional access will be difficult.

8. Climatic change and rise in sea level

The indications are that a rise in sea level will occur as a consequence of the climatic change. But a lack of adequate data and uncertainties concerning the magnitude of anticipated climatic changes hamper the analysis of the potential impact. While Tonga is participating in the regional program of sea level monitoring, there is as yet no translation of the universal concern for sea-level rise into land use planning within the country, particularly within the urban areas.

9. Alternate sources of sand

The construction of modern facilities for industrial development, and of the infrastructure needed to support

an expansion of tourism, requires large volumes of construction grade sand for cement, mortar, and the manufacture of concrete blocks. In addition, large volumes of sand are traditionally used for graves in public cemeteries.

To meet those needs, sand has been removed from beaches in all major island groups. Many of the popular beaches have already been stripped of sand. With the prospect of tourism making a significant contribution to the economy of Tonga, the protection of one of the prime tourist assets -the beaches- is mandatory. The need for alternative sources of sand is a serious constraint, and further effort will be directed to locating and developing less environmentally sensitive sources of sand.

10. Level of public environmental education

A major constraint is seen as the limited encouragement of active public participation in the environmental debate, and particularly in the area of environmental comment on development proposals. There are notable exceptions, such as the vigorous debate which surrounded the proposed importation of hazardous wastes for electricity generation. As EIA legislation comes into play, a process of public participation will be vital for any proposal which has potential environmental significance. The EPS will be called on to play an increasingly important role in the education of the public on environmental issues.

At the formal educational level, the environment is treated as a subject in its own right at the primary education level, but there is no similar treatment at the secondary and tertiary levels. Specific environmental curricula are needed which draw on material currently included within general subjects, such as geography, but amplifying these in a way meaningful to the environmental concerns of the Kingdom.

Much effort has gone into the preparation of Environmental Science teaching materials, but further effort is needed to ensure effective implementation, both in the formal teaching process and through practical hands-on activity and community extension. In the preparation of educational materials, the Education Ministry draws on the expertise of several staff, but none has any specific training in environmental science. The Ministry of Lands, Survey and Natural Resources has such trained staff and is working independently of the Ministry of Education in drawing up school curricula on environmental education. There is an apparent need therefore for closer communication and cooperation between the two ministries.

The school curriculum lays emphasis currently on classroom teaching and the need is to extend this teaching activity into the community, taking classes into real life situations and taking an active involvement in practical environmental activities. The EPS interaction with the schools on Tongatapu, and especially through Environmental Awareness Week, aims to do exactly that. But the constraints of funds and staffing permit little opportunity beyond the EAW, and for activities in other Island Groups.

11. Legislative constraints

There is a lack of specific environmental legislation to support institutional arrangements and establish a clear mandate for proper environmental protection and sustainable development in the Kingdom. A number of organisations have offered assistance to Tonga with legislative review and drafting and the Government is proceeding cautiously with the process for enacting new legislation.

In addition to broad environmental legislation, there is a lack of specific legislation which comprehensively addresses the evaluation, importation, storage, safe use, disposal and monitoring of all hazardous chemicals, including pesticides.

A major apparent legislative constraint is an unwillingness or inability to enforce the penal provisions. Indeed the difficulty of using 'police' action within a small community where extended close family ties exist may be such that the possible effectiveness of the legislative approach needs to be questioned. The application of communal-based penalties on offenders may be more appropriate.

12. Youth employment prospects

The demographic structure of the Kingdom is of concern to the Government, particularly with over 40% of the population being under 21 years of age. Apart from the pressure on the education system itself, paid full-time employment opportunities are scarce for the annual efflux of school leavers. The subsistence economy does absorb a large number of young, so the problem is not employment per se, but under-employment in the cash economy.

The Government is making a strong push to provide an economic environment in which private enterprise can flourish, attracting new commercial ventures to the country. And it is expected by the Government that expanding commercial agriculture, industry and other private enterprise will absorb many of the annual crop of school leavers.

C. Opportunities for Sustainable Development

1. Urban planning for the Greater Nuku'alofa area

The major constraint is the availability of land which is suited to urban settlement. Low-lying land is not suited, environmentally, socially, and economically. The cost of making such land habitable even now will indeed be large because of the large amount of fill required, which has to be quarried and transported from somewhere else. With the potential rise in sea level which is expected in the next 50 years, what will be the cost of further fill to raise the house sites by at least one metre? Or to build a wall or a series of dykes to keep the sea out?

What other alternatives might there be? A few possibilities are given below, some perhaps more palatable than others.

- Government reclamation of low lying areas for subdivision for settlement, with the establishment of proper roads, sewers, and drainage systems.
- A land use policy which permits incompatible, but not irreversibly damaging, land uses for a designated period, with phased transition to compatible, environmentally benign usages.
- Medium density, planned communities with shared amenities, and proper public transportation and communication modes.
- Urban development with centralised amenity areas (shops, offices, recreation, etc.), with vehicle access restricted to delivery and public transport in order to reduce congestion and pollution.
- Implementation of exclusive zoning practices on more sensitive areas to protect ecosystems and other desirable environmental values.

In all cases above, the first step will be the preparation, with full public participation, of an Urban Development Plan for Nuku'alofa and Environs, with special attention to environmental planning for the low-lying areas and for the immediate coastal zone with its rapidly diminishing mangrove resources.

The Government of Tonga has recognised the central need for better urban planning, and within the broader context of national land use planning. All areas are addressed by priority projects within the submission to Government for the current Budget Estimates.

2. Control of population growth and employment opportunity

While it is suggested that a reduction in the level of emigration by Tongans to other South Pacific countries, particularly New Zealand and Australia, is inevitable, simply because the same opportunity will not be there as was previously the case, the US is identified as a recipient country. Hence the current level of emigration may be maintained and remittances continue to underpin the economy.

Should both the rate of migration and the level of remittance payments diminish, the economic foundations for having large families will be under strong attack. Youth unemployment in the cash economy is already high in Tonga and as these youth marry and produce families, it is quite likely they will become an increasing financial burden on their parents, rather than contributing to a greater economic ease and standard of living for their parents in their advancing years as was the case with remittances flowing in from large numbers of progeny working overseas.

Will this create stronger pressure for the introduction of birth control measures? It is suggested the answer will be yes but, because of the strong Christian religious beliefs of Tongans, it will be a slow development.

A positive initiative of Government is the continuation at all speed to provide incentives for entrepreneurial and industrial activity which will create employment and prosperity at home. Inevitably, this will entail an environmental damage cost. But it is unrealistic to expect there to be no damage. Tonga's goal should be to minimise the extent of environmental damage as far as that is realistically sustainable within the urgent need for development activity; and striving to ensure that damage caused is not irreversible, for that future day when the economic benefits of the development can be applied to restoring the damage incurred.

3. The productive sector

Agricultural production

Agricultural production programs of the government will have a balanced focus on both intensive horticultural production and on more traditionally based agroforestry pursuits.

Some of the intensive production activity is high risk, both in terms of marketing and to some extent in terms of production itself. The economic gains can be quite attractive to producers and marketeers alike and the entrepreneurial spirit involved can only be welcomed. But to ensure that such intensive production can be sustained, considerably more knowledge is required of how the soils of Tonga will perform under intensive cropping regimes, both in terms of soil structure and fertility. Elsewhere, intensive cultivated crops are sustained by fertiliser applications and chemical control of insect pests and fungal diseases.

Because of the fragility of the groundwater aquifer system and its vulnerability to pollution from percolated agricultural chemicals, any moves towards expanding current activity should proceed very cautiously until the site factors and reaction of soil types to the intensive cropping practices are clearly understood.

Forest production

While the contribution of forestry to GDP is now minuscule, there is clear scope for a greatly increased contribution to GDP through focussing on the production of relatively fast growing, high value (cabinet wood) species, both on 'Eua and in urban environs of Nuku'alofa itself.

Where the market value of flitches of Australian red cedar grown on 'Eua can be expected to be not less than T$1,500 per cubic metre f.o.b., and with an assured market niche, then a feasibility study would be small investment.

The secure allocation of further land for reforestation purposes on 'Eua is a first requirement. Land assigned

for reforestation on 'Eua has now been planted, but this area is below that needed to generate the minimum scale of operation for a viable industry. This land constraint could be eased through the re-adoption of a planned urban forestry program with economically valuable species established as avenue planting, with appropriate management and protection from damage.

Further urban planting would continue to be specifically for firewood as a cash crop earning opportunity to supply the Nuku'alofa market, and for other special purpose trees and shrubs, such as handicraft species.

Marine

The immediate focus of the Fisheries Division is to undertake surveys of the marine resource and establish a resource database. The Division's other equally urgent need is to expand the level of monitoring, particularly in the inshore and nearshore reef fisheries. To undertake this, the extension capacity of the Division will need to be expanded.

Industry

It is essential to develop and police regulatory measures, with strong penalty provisions, to discourage industrial and commercial pollution.

As government departments are known on occasion to be major polluters themselves, the principle must apply equally to government as to private individuals and industry. Such controls will require the support of all sectors if international co-operation is to be secured.

A concerted effort is also required to foster the exchange of information to discourage trade in environmentally unsound technology.

Sand and aggregate for construction

One of Tongatapu's pressing problems has been for suitable sand (and aggregate) for construction. Traditionally elsewhere in the Pacific, coral blocks were used for 'stone' buildings, the lime mortar being produced on the beach also from burned and pounded coral. The foreshore area has been the main source of sand and this mining has severely damaged some beaches and foreshore areas, impacting one of the major natural tourist assets.

While the foreshore zone is a convenient source of material, sand and aggregate could be obtained from government and private coral limestone quarries well away from the foreshore. Resources of hard limestone exist where modern stone sawing techniques can be use for production of limestone building blocks and crushing plants operated to produce sand and aggregate for concrete. The 150 year old limestone block buildings in the Cook Islands testify to their durability and the aesthetic problem of weathering and algal staining of the exposed limestone block surfaces can be countered with modern sealing compounds commonly used with concrete high-rise development.

The Government has an opportunity to ensure sustained use of the beach resource by strictly enforcing the prohibition on the removal of unapproved sand from the foreshore zone. The Government could also consider commissioning a study to provide guidelines for quarry operations to ensure continued community benefit (eg. as a sports oval) continues after the quarry is exhausted.

The Government is also in the process of considering a study on construction materials, and it is suggested that this study be extended to include a detailed feasibility study together with practical on-site demonstration on the use of sawn limestone block as a primary construction material; and on the supply of construction grade sand and aggregate from limestone crushing plants.

4. National park and reserve development

The Kingdom's system of protected terrestrial areas is poorly developed. Natural flora and fauna have been degraded over a long time span and there are few areas remaining which contain remnants of what are thought to be original ecosystems.

The most significant of these, and which is fast being encroached on by gardening, lies in the south-east of 'Eua. Proposals for the establishment of a protected area there have been discussed for two decades without any concrete action. The large size of the proposed reserve may have served as a constraint to declaration.

Declaration of a national park on 'Eua now appears possible by the end of 1991. Such declaration will give the green light to the ADB pipeline project for national park development in its 'Eua Integrated Regional Development Project and also to the EC's proposed funding for the 'Eua National Park.

Similar reservation should be pursued for the 300 ha area of forest on Tofua to make Tonga's second national terrestrial park. While it is unlikely to be extensively cleared because of its remoteness, national park declaration remains desirable.

Concurrent with such national park declaration, other areas containing a high level of endemic species should be formally identified, surveyed and considered for declaration as protected areas. Informal identification of such areas has been made by the EPS. For, example, the volcanic islands of Tafahi and Kao have undisturbed cloud forest on steep slopes, while other small, indigenous forests of note occur on Niuatoputapu and Late. Patches of better quality forest still occur on Vava'u.

5. Land use monitoring

Tonga needs to strengthen environment monitoring and assessment capabilities (EMA). A Regional Project has been proposed as a co-funding exercise by the Asian Development Bank and GRID/GEMS of UNEP to provide technical assistance for the establishment within SPREP of a geographic information system database (GIS), and of an EMA/GIS Unit which would support national database development in the region with enhanced, image-processing capabilities, such that few Pacific nations could justify on their own. This regional project would establish an EMA network with regional and national training programs in EMA/GIS processes.

As a fundamental tool required for database development and for use in monitoring changes in land use, new high resolution colour aerial photography is required. The most recent available complete photographic coverage of Tonga was flown in 1968.

6. Water

Much is being done in the area of groundwater resource survey as the precursor to improved water supplies to the main urban centres. The main gap in the water program concerns the monitoring of the quality of groundwater supplies.

The Government's policy in promoting the self-help development of rainwater catchment collection systems is very desirable. Such development could be assisted by the provision of a line of credit through the Tonga Development Bank for low interest loans to householders seeking to install rainwater catchment and storage systems. Priority should be given to those areas not already supplied with reticulated water, or those where the water supply is unfit for drinking.

Consideration could also be given to making it a requirement in the building code for water catchment and storage systems to be made mandatory on all new community buildings, including churches, in the outer island areas. A particular need is seen for the Ha'apai Group; for such needy areas, specific purpose grants

could be considered to all religious denominations for the installation of roof gutters and cisterns to provide emergency community supplies for periods of extended drought periods such as in 1987.

With proper design, the first salty discharge from a roof catchment during a storm can be spilled to waste and tanks themselves can be self-cleaning. Roof and gutter materials should be selected which will have a long life in salt-air environments.

The Tonga Water Supply Master Plan Study is developing a set of recommendations for the main areas of reticulated water. These are at Nuku'alofa, Pangai, Neiafu and 'Eua. Preparation of Master plans for development of water supplies for villages is based on a study of representative villages. The plans prepared for new or upgraded water supplies to these representative villages will provide models for studies to be made for other villages.

The following recommendations would have a high opportunity cost, underwriting all social and economic development.

- Systems be established to monitor the quantity and quality ofthe groundwater resource. Quantity monitoring would include: establishing annual rainfall recharge and assessment of safe pumping yield, coupled with water level monitoring and pumping rates.

  Quality monitoring would include the regular collection of water samples for laboratory analysis for organic and inorganic chemical contamination, for bacterial contamination and for saltwater intrusion.

- Water supply authorities work closely with the Health Department to educate the community on the need to protect their groundwater resource from contamination from human wastes and agricultural chemicals, and the methods of doing so.

- A national policy be developed for rainwater collection and storage with external technical assistance as necessary, and long-term implementation packages be prepared for funding consideration by aid donors.

7. Energy

The following opportunities for sustainable development are given high priority:

- regulation of the control of the quality of fuel for use in vehicles and for electricity generation;

- development and implementation of energy conservation programs- especially in outer islands so dependent now on diesel fuel imports;

- expansion of current fuelwood planting schemes on Tongatapu to supply household needs for cooking;

- sponsorship of training and public awareness programs to educate the community on energy efficiency and practical renewable energy resources.

8. Lagoon rehabilitation on Tongatapu

Two lagoons on the north coast of Tongatapu, Sopu and Puke, were destroyed when cut off from the sea by the construction of a seawall which also carries a coastal access road. If the original intention was to reclaim the old lagoons for household allotments, the capital requirements for this would be a severe drain on the Government's capacity to undertake other development activity.

One treatment of the area, which would be environmentally desirable, would be to re-open the lagoons to the sea and restore, as far as possible, their original marine function as valued fishing grounds. Some dredging

will be required and the fill could assist with land reclamation of low-lying areas adjacent to the lagoons.

9. Coastal swamp and mangrove areas

Due to the limited availability of land, mangrove areas in Tongatapu and Vava'u have been allocated for housing allotments. Where mangrove is landfilled, the EMP reports that the land is rarely raised to a sufficient height to escape the danger of flooding during storms or even from unusually high king tides. As a result, in addition to property loss, sewerage is inadequate and severe health hazards can arise due to flooding of pit latrines and septic tanks.

The consequences of the settlement of such areas are compounded by the expected rise in sea level over the next 50 years due to global warming. While there is debate over how high that rise will be and on the time span, there is general scientific agreement that a rise in sea-level will occur.

If additional land can no longer be made available to meet the needs of an expanding population, there may be no alternative but to investigating alternative styles of community housing in existing urban centres at higher elevations. And this may need to include medium-density housing estates, or high rise, repugnant as that may be for many Tongans, coupled with a loss in the capacity to garden, and hence greater dependence on the cash economy.

10. Garbage dumps

Waste disposal is widely recognised as a serious problem in Tonga, particularly in Nuku'alofa where household garbage and other non-hazardous waste, including sanitary waste, are dumped in a mangrove area near the city. The refuse tip area has become a squatter settlement and the squalid, unhealthy surroundings, rats and disease risk are an embarrassment to the country.

The government has selected an alternative land-fill site and has been studying alternative sites for rehousing the squatters, subjected to EIA. But considerable further effort will be required to plan and manage a waste disposal system to ensure it meets community's needs, offensive smells are minimised and no health hazard results.

D. Supporting Measures

1. Institutional and administration measures

Environment Planning Section (EPS)

Longer-term organisational considerations of the EPS must first await consideration by the ECG of the government's administrative arrangements. Institutional needs for environmental administration will be considered by SPREP under the Regional Environment Technical Assistance program.

However, because of the 'loss' of 4 staff overseas for training, there is a need to provide special staff support to the EPS until the end of 1992 if it is to have any capacity to conduct the business with which it is charged.

Natural Emergency Services (NES)

Tonga is subject to severe environmental damage from naturally occurring events, including cyclones with high velocity winds, tidal surge and extensive flooding; tropical storms with very high intensity rainfall; lightning strikes and resulting fires; earthquake; or prolonged drought. All can occur in Tonga.

Trees, coconut groves and crops are destroyed, the coast erodes, soil is washed away, areas are inundated

with salt water, and the water supply is contaminated with salt and mud. Severe damage occurs to infrastructure, and health and housing problems, never absent, are exacerbated.

There is a National Office for Disaster Relief and Rehabilitation in the Kingdom, but still Tonga has need of an organisation which does not merely respond to an emergency which has occurred, such as the 1982 Cyclone Isaac, but prepares the Kingdom in advance of such catastrophes in order to mitigate their consequences. An NES's immediate and continuing role would be to prepare contingency plans for emergency situations, and to hold emergency supplies of equipment and food for early relief. Neighbouring friendly countries will no doubt spring into quick action in the event of an emergency, as they have done in the past, but the supply of distant help takes time. And that time may cost many lives.

An NES would be responsible for developing the emergency roles of the various arms of government and training staff to respond in a planned way to different types of emergencies. An institutional study to define the role, structure and staffing should be included on the aid funding agenda.

Staffing and training

An assessment of staff and training needs of the EPS is included in the RETA. Another pressing staffing need is for an educator who is professionally trained in environmental science to co-ordinate curriculum development activity and delivery in the Ministry of Education.

This coordinator would draw on expertise available both within the Ministry and elsewhere for preparation of environmental training materials and for arranging practical environmental learning experiences. There are highly-trained Tongans with the necessary leadership and co-ordination skills and therefore external assistance need not be required.

Budget

There should be no doubt about the sincerity of the Kingdom's concern for the environment, nor its commitment to correcting environmental mistakes of the past and planning carefully for the future. At the same time, because of fiscal constraints, the level of funding provided through the Ministry of Lands, Survey and Natural Resources to its Environmental Planning Section for environmental activity is indeed small. In the 1990/91 financial year, a mere T$ 70,126 for everything - salaries of staff and operational costs.

While the Ministry could allocate more than 7.28% of its total annual budget of T$ 963,197 to the EPS, the Ministry comprises eight sections, all of which are competing for funds. Taken in the context of the total annual budget for the Kingdom, environmental administration receives 0.14%. This amount will increase over time as the operations and responsibilities of the EPS begin to gain shape and expand.

Consideration should be given to supplementing limited local resources with overseas development assistance to enable the Environmental Planning Section to increase its level of activity.

2. Legislation, conventions and treaties

The ESCAP/IDEC Symposium identified the need for environmental legislation to provide the framework for environmental protection and sustainable development in the Kingdom of Tonga.

The government has moved to draft Land Use, Natural Resource and Environment Planning legislation for its consideration.

3. Environmental education, communication and public awareness

The IDEC Symposium identified the need for public awareness and education as an urgent, top priority in

order to ensure the success of environmental programs. National Environmental Education Curricula and projects promoting public environmental awareness should receive immediate priority.

Such training is so important and also so universal a need in the Pacific, that a Regional approach is called for, supplemented by carefully tailored national education programs. SPREP is recognised as the regional vehicle for the delivery of such training programs, both formal training and in-country short course or on-the-job training such as will be undertaken by the RETA.

V. PROCEDURAL MATTERS

The Kingdom of Tonga is fortunate in having a standing Inter-departmental Environment Committee (IDEC), originally established to coordinate the compilation and review of an Environment Management Plan. IDEC membership comprises the heads of the Ministries of Lands, Surveys and Natural Resources; Health; Foreign Affairs; Agriculture and Forestry; Fisheries; Works; Labour, Commerce and Industries; Central Planning; and the Tonga Visitors Bureau. The IDEC is chaired by the Secretary of Lands, Survey and Natural Resources, Mr Sione Latu'ila Tongilava.

A Team was established under the auspices of the IDEC for the preparation of the UNCED National Report. This team comprised Mrs Netatua P. Fifita, Acting Ecologist and Environmentalist, Environment Planning Section and Mr Taniela Tukia, Physical Planner, both of the Ministry of Lands, Survey and Natural Resources, and an environmental management specialist, Dr Robert Thistlethwaite of Integlan Australia P/L. Special acknowledgment is made of the assistance of other MLSNR staff, most notably Lilia Jiminez and Lindsay Furness. The Team's work was greatly assisted by the support of the Central Planning Department, and particularly through access to relevant sections of the draft DPVI report.

Work on the report commenced in Nuku'alofa on Friday 26 April 1991 and the first draft then circulated to members of IDEC on Monday 6 May in advance of a full meeting of the IDEC called for Thursday 9 May. At that meeting, the circulated draft was critically examined, in conjunction with modified sections of a second revised draft.

At the 9 May meeting, the IDEC endorsed the structure and content of the report, subject to some textual revision. A third revised draft was then prepared by the Tongan members of the Team to satisfy IDEC's requirements and the computer disk delivered by Sione Tongilava to Bob Thistlethwaite for preparation of the penultimate draft report.

The IDEC Chairman subsequently submitted the draft to the Acting Minister of Lands, Survey and Natural Resources, the Honourable Dr S. Ma'afu Tupou, who sought and received Cabinet's approval for the National Report on 29 May 1991.

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