NEMS

REPUBLIC OF

NAURU

NATIONAL ENVIRONMENTAL MANAGEMENT STRATEGY

AND

NATIONAL ENVIRONMENTAL ACTION PLAN

Prepared by

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and the

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in association with the

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DEDICATION

To our Nauruan ancestors who, for over three thousands years, nurtured and cared for our God given island of Nauru as our inheritance, and our children and grandchildren's inheritance for generations and generations to come, and who receive our blessings in their quest for sustainable development.

FOREWORD

The lessons of the past are clear not only for Nauruans but for the rest of the world as well. Waste not this precious planet, or you shall want. Squander non-renewable resources at your risk. Destroy land, and you destroy human culture. Devastate the forest, and you will lose the coral reef as well, for the forest and the reef are like husband and wife. (extract from Nauru's Plenary Address to the "United Nations Global Conference on the Sustainable Development of Small Island Developing States", Bridgetown, Barbados, 1994).

Our beautiful, productive island of Nauru was bequeathed to us by God, our Heavenly Father. It our is duty to Him and to His children on Nauru to care for and rebuild this priceless gift so that we can live a harmonious sustainable Christian existence forever and ever under his merciful guidance.

War and ninety years of phosphate mining have stripped the heart out of Nauru to enrich the soils of other lands. Although the soul of our island remains alive in our people, plants, animals and reefs, they too are in grave danger. As Nauruans, we must take some responsibility for the weakening of our spiritual links with our environment and the loss of traditional sustainable ways of using and caring for it.

For three thousand years, we lived in harmony with our land and sea, producing what we needed. Over the past century, however, our island has been called upon to produce more than could be sustained. This call was to fuel development fires on foreign shores and to shower our people with goods and services, many of which were in excess of our needs. This has led to serious breakdown in our island environment and the physical and spiritual health of our people. If this environmental trend is not reversed, Nauru will not survive, as we know her, into the 21st century and beyond.

The purpose of our National Environmental Management Strategy (NEMS) is to identify development programs that will be sustainable and that will ensure that our children and their children inherit an island with a heart **and** a soul, a Nauru that they can love and thrive on. This will be a Nauru with a blend of traditional and modern ways of life, of traditional and modern environmental management and development strategies.

The NEMS is not a map for a return to the days of subsistence, but a blueprint for the development of a sustainable Nauruan island way of life. Whereas Rehabilitation will put the heart back into Nauru, it is hoped that the NEMS will ensure that our soul, our island culture and island environment, will remain healthy and productive for the benefit of future generations. We must make Nauru whole, once again, by rehabilitating the heartland and re-kindling our spiritual links with our island environment. The key word is SUSTAINABILITY, meaning that everything that we do - all the projects that we create and carry out - must be designed to last for the long term, without using up our precious resources in our own lifetimes.

The NEMS maps a return to the idea of stewardship of our God-given land and seas, of looking after them for future generations. We must develop an attitude of caring - an "Environmental Credo":

"We shall live our lives without hurting our environment or our culture."

"We shall learn as much about our environment and culture as we are able."

"We shall not exploit our land or marine environment for food or resources beyond what is needed by ourselves or our family."

"We shall cooperate with our community in deciding what is best for our environment, and shall be actively involved in the decision-making process."

"We shall encourage our Government to abide by the Principles of Sustainable Development and to protect our natural and financial resources as the capital needed for future development."

"We shall develop a new model of Nauruan life which is a blend of traditional concerns for our island home, and modern technology."

"We shall, in the name of God, do everything in our power to protect and nurture our island environment, our children and our island plant and animals as His gift to us as a basis for sustainable living on Nauru for ever and ever."

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ACKNOWLEDGEMENTS

This National Environmental Management Strategy (NEMS) has been developed by and for the Government and people of Nauru with funding and technical support from the South Pacific Regional Environment Programme (SPREP), the United Nations Development Programme (UNDP) and AusAID. Many individuals have assisted in the production of this document by giving of their time, their thoughts, their ideas and their hopes and aspirations for Nauru's future. There is a list of all people consulted by us, as the SPREP NEMS consultants, in 1995 and 1996, in Appendix 2. There are also many more people who helped us while we were working on the Flora of Nauru in 1980-81, giving testimony to the Commission of Inquiry in 1987, and working as team members of the Nauru-Australian Cooperative Rehabilitation and Development Feasibility Study in 1994. Although we can not possibly thank everyone, there is a core of people who made significant contributions to our knowledge of Nauru, facilitated our work, and made us feel at home on Nauru. These are gratefully acknowledged. We sincerely apologise for those persons we have failed to mention.

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The Honourable Lagamot Harris, President of Nauru, Liaison Officer on the NACRDFS, has been very instrumental in providing us with an overall understanding of the problems related to rehabilitation of the island and providing a clear vision of what a sustainable future for Nauru could be. We also thank the former President, His Excellency Bernard Dowiyigo, for sharing with us his concerns over Nauru's future. Special thanks also goes to Leo Keke, Chief Secretary, who gave freely of both general and legal advice to the team, and facilitated the initiation and conduct of the study.

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The consultants would also like to acknowledge the assistance of a number of persons, whose help and hospitality in Nauru, during a number of earlier visits to Nauru, provided a foundation of knowledge on Nauru's environment which has helped us in the preparation of this NEMS. In particular, we would like to thank the late Honorable Joseph Detsimea Audoa, former Minister of Health and Education and Minister of Justice in the Government of Nauru, who, because of his vision and commitment to the culture and environment of Nauru, initiated and provided the financial support for the study of the flora of Nauru that we began in 1980.

We also acknowledge Mr. Lisle Newby, the then Director of Education, who, along with Joe Audoa, were the main supporters of the project, and who provided valuable logistical support throughout. Special thanks are also given to our main local informants and assistants, some of whom have passed away. These include the Reverend James Aingimea, who coordinated most of our work, and Jacob Gabwinare, Henry Michael Heine, Daphne Fotu, Katarina Satto, Kenia Raidinen, Reynold Capelle, Eda Adam and Montiba Star, our main informants in relation to the cultural uses and Nauruan names of plants.

Our thanks also goes to the Honorable Lawrence Stephen, Minister of Education during part of the project; Obera Menke, Robert Kaierua, Leo Keke, Dennis and Ria Berdinner, Dennis Ketner, Sio Fotu, Pine Harrison, John Brechtefeld, Rene Harris, Porthos Bop, Jacob Aroi, Leon Thompson, Benjamin Morgan, Iosefa Elisala and Teaora Tabanou, all of whom contributed in some way to the success of the study.

Our thanks also go to our co-authors on the *Flora of Nauru*, the late Emeritus Professor of Botany of the Smithsonian Institution National Museum of Natural History, whose knowledge of the Micronesian environment was unparalleled, and Dr. Harley Manner of the University of Guam, who played such an important role in the studies of the regeneration of vegetation of the mined areas of Topside.

To others who helped in any way during our study, we also give thanks, and sincerely apologise for failing to mention you by name.

Finally we would like to thank SPREP, which through its Capacity 21 Programme, has funded the production of this NEMS. Particular thanks goes to Vili Fuavau, Jo Reti and Neva Wendt for their support, technical input, and patience. We would also like to thank The University of the South Pacific for the support it has provided throughout the duration of the study, both as the subcontractor to SPREP, and as Nauru's own university of which it is one of twelve regional member countries.

Finally, we wish to express our heartfelt thanks to the people of Nauru whose warmth and hospitality made our work on their beautiful but damaged island so enjoyable and worthwhile. We hope that this Nauru National Environmental Management Strategy does justice to you and will provide a foundation for sustainable living on your beautiful island forever.

To all of you, ***TUBWA KOR***,

Randy Thaman and Dave Hassall
Suva, Fiji
February 1996

MESSAGE FROM SPREP

ACRONYMS AND ABBREVIATIONS

ADB	Asian Development Bank
AIDAB	Australian International Development Assistance Bureau (now AusAID)
ARM	Atmospheric Radiation Measurement Program of the U.S. Department of Energy
ASIS	Alliance of Small Island States
AusAID	Australian Aid for International Development (formerly AIDAB)
CA	Conservation Area
CBBC	Community-Based Biodiversity Conservation
CBD	Convention on Biological Diversity
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CTBT	Comprehensive Test Ban Treaty
EEC	European Community
EEZ	Exclusive (Extended) (200-mile) Economic Zone
ENSO	El Nino (Ninyo) Southern Oscillation
EIA	Environmental Impact Assessment
ESCAP	Economic and Social Commission for Asia and the Pacific
FAO	Food and Agriculture Organization of the United Nations
FFA	Forum Fisheries Agency
FSP	Foundation for the Peoples of the South Pacific
GEF	Global Environment Facility
GIS	Geographical Information System
GNP	Gross National Product
IDI	Ministry (Department) of Island Development and Industry
IPCC	Intergovernmental Panel on Climate Change
KTFE	Kiribati Task Force on the Environment
MHMS	Ministry of Health and Medical Services
MWCS	Ministry of Works and Community Services
NACRDFS	Nauru-Australia Cooperation Rehabilitation and Development Feasibility Study
NDA	Nauru Divers Association
NDP	National Development Plan
NECC	National Environmental Coordinating Committee
NEAP	National Environmental Action Plan
NEA	Nauru Environment Association
NEMS	National Environmental Management Strategy
NFRA	Nauru Fishermen's Association
NGO	Non-Government Organisation
NIC	Nauru Island Council
NOAA	US National Oceanic and Atmospheric Administration
NPC	Nauru Phosphate Corporation
NRA	Nauru Rehabilitation Authority
NWA	Nauru Women's Association
NWC	Nauru Women's Circle
PEDP	UNDP Pacific Energy Development Programme

PHC	Primary Health Care
PIDC	Pacific Island Developing Countries
PRAP	Pacific Regional Agricultural Programme (European Community)
PSDNP	Pacific Sustainable Development Networking Programme
SCUBA	Self-Contained Underwater Breathing Apparatus
SOPAC	South Pacific Applied Geoscience Commission
SPACHEE	South Pacific Action Committee for Human Ecology and the Environment
SPBCP	South Pacific Biodiversity Conservation Programme
SPC	South Pacific Commission
SPFDP	FAO/UNDP South Pacific Forestry Development Programme
SPREP	South Pacific Regional Environment Programme
TOGA	Tropical Oceanic Global Atmosphere Programme
UNCD	United Nations Conference on Disarmament (Geneva)
UNCED	United Nations Conference on Environment and Development
UNCLOS	United Nations Convention on the Law of the Sea
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFPA	United Nations Fund for Population Activities
UNICEF	United Nations Children's Fund
USAID	United States Aid in Development
USP	University of the South Pacific
WHO	World Health Organisation of the United Nations
WINA	Women's Information and News Agency

EXECUTIVE SUMMARY

This National Environmental Management Strategy (NEMS) and National Environmental Action Plan (NEAP) for the Republic of Nauru has been compiled with the assistance of many people in the Government, the Public Service and from the general public of Nauru. Its preparation was commissioned by the Department of Island Development and Industry (IDI) on behalf of the Government of Nauru and funded by the South Pacific Regional Environment Programme (SPREP).

Although phosphate mining has brought great economic benefits to both Nauru as a nation and to Nauruan landowners, it has been at great environmental cost. Two World Wars, other types of development, increasing population pressure and urbanisation have also had negative impacts on Nauru's environment and people. The importance of protecting the environment and Nauru's renewable natural resources is made more urgent by the fact that the mining of phosphate, as a non-renewable capital resource and a source of income, will probably cease shortly after the turn of the century.

The NEMS is an attempt to outline an environmentally and culturally sustainable development model which will ensure that Nauruans continue to have access to goods and services of urban-industrial societies that can make life safer, healthier and more enjoyable, while **at the same time** protecting our island environment and cultural traditions as the capital needed for the development of future generations. In other words, the NEMS represents a first attempt to identify ways of achieving a balance between traditional island life and a Western urban lifestyle.

SCOPE OF THE NEMS

Like NEMS that have been prepared for other Pacific Island nations, this NEMS should be viewed as only a vital first step in identifying appropriate issues and strategies for promoting environmentally sustainable development in Nauru. As circumstances change, so will the priorities for implementation of different programs and activities. For the time being, the issues that are currently of greatest concern to Nauruans have been addressed. New issues will no doubt arise, and existing ones become less urgent. Whatever changes occur, the central principle of environmental and cultural sustainability will always apply.

There were four guiding principles for the preparation and implementation of the NEMS that will, hopefully, ensure it's workability and success. These were:

1. That there must be an exhaustive, and continuing, process of consultation and consensus building;

2. That the NEMS must be based on what is currently known about the environment, and equally important, what is not known;

3. That priorities, the formulation of policy, and the resultant National Environmental Action Plan (NEAP), as the most important component of the NEMS, should depend on the results of the first two stages; and,

4. That the implementation of programs and activities suggested in the NEMS and the NEAP be constantly monitored, modified or changed over time based on both changing priorities of the Nauruan people and on the acquisition of new information or feedback on existing programs or activities and the state of Nauru's environment.

NATIONAL ENVIRONMENTAL ACTION PLAN AND IMPLEMENTATION

The NEMS includes a National Environmental Action Plan (NEAP) and a range of objectives and programs that can serve as a basis for the promotion of environmentally sustainable development. The recommendations and views expressed should be only taken as possibilities - as suggestions that need to be ratified and continually discussed by Nauru's people and their Government. The program of implementation will rely on a focussed and comprehensive environmental policy as ratified by the Government and the Nauruan people.

In many cases, funding will need to be identified before meaningful work can be undertaken. This will prove an obstacle for some projects. Nevertheless, external sources may be approached to provide sponsorship, and the National Environmental Coordinating Committee (NECC) will hopefully be able to undertake an assessment of these possibilities. SPREP, for example, could fund conservation area development under its South Pacific Biodiversity Conservation Programme (SPBCP), whereas some activities can be implemented by local communities themselves or non-government organisations (NGOs), and other can be implemented by the government, without significant additional funding, as part of its ongoing sectoral development activities.

THE NAURU ENVIRONMENT

Chapter 2 of the NEMS provides general background information on the physical, biological and cultural environment of Nauru. It constitutes a "State of the Environment Report" for Nauru which can serve as a basis for policy formulation and prioritisation and the identification of types of information that still need to be gathered or updated. Included in this chapter are discussions of Nauru's geographic location, hydrology, geology and geomorphology, climate, soils, flora and vegetation, terrestrial fauna and marine life. Information on the cultural environment includes discussions of Nauru's people and culture, the traditional subsistence economy, land tenure, development history, and the contemporary economy.

ENVIRONMENTAL INSTITUTIONS AND LEGISLATION

Chapter 3 is an analysis of the status of current environmental institutions and legislation in the country. Information is provided on a range of government and non-government institutions or organisations which have responsibilities for environment-related matters and for the enforcement of existing legislation. These include Government Ministries, with particular focus on the Department of Island Development and Industry (IDI), the Nauru Phosphate Corporation (NPC), the Nauru Island Council (NIC), non-government organisations (NGOs), and the proposed Nauru Environmental Coordinating Committee (NECC).

Also provided is a review of existing legislation related to environmental issues and international treaties, agreements and conventions that relate to environmental issues and to which the Republic of Nauru is signatory.

ENVIRONMENTAL CONSTRAINTS AND CHALLENGES

Chapter 4 is a discussion of the major issues and constraints to environmentally sustainable development in Nauru that were identified during consultations in Nauru in 1995 and 1996. These are prioritised to some extent, and grouped together under fourteen main headings. The main constraints to environmentally sustainable development that constitute the main challenges that need to be addressed by the NEMS and the Environmental Action Plan include:

1. Land degradation, including severe degradation due to phosphate mining, coastal erosion and loss of soil.

2 Inadequate environmental education, public awareness and training, including loss of traditional environmental knowledge and awareness, inadequate public environmental awareness, and inadequate environmental and science education.

3. Inadequate environmental infrastructure and legislation, including the need for land tenure reform and the development of an environmental data base.

4. loss of biodiversity, including the loss of both species and ecosystem diversity and the loss of traditional varieties of important cultural plants.

5. Coral reef and marine resource degradation and overexploitation, including the breakdown of traditional marine tenure and resource-use systems, the inability to optimally exploit pelagic and deep sea fisheries resources, and the breakdown of the traditional aquacultural system.

6. Pest and disease infestations, including the need for the strengthening of quarantine procedure to ensure that serious new pests and diseases are not introduced into Nauru.

7. Pollution and waste management, including the problems of solid waste management, water pollution, sewage treatment, air pollution and noise pollution.

8. Population growth and urbanization.

9. Health and nutritional deterioration.

10. Economic vulnerability and instability.

11. Inadequate development infrastructure and services.

12. Global climate change, in particular the threats posed by sea-level rise due to global warming and increasing ultraviolet radiation due to the breakdown in the Earth's protective ozone layer.

13. Radioactivity and nuclear pollution an their known detrimental effects on human health and the environment.

14. International traffic in toxic and hazardous waste

NATIONAL ENVIRONMENTAL ACTION PLAN

Chapter 5 is a National Environmental Action Plan (NEAP) for Nauru. It is the most important part of the National Environmental Management Strategy. The NEAP consists of a range of Action Plan "Objectives" and associated "Programs" under each Objective that can be implemented to address the main issues and constraints to environmentally and culturally sustainable development described in Chapter 4.

The programs and activities are not necessarily listed in order of importance, although some, such as the rehabilitation of the mined-out areas of Nauru, the strengthening of environmental awareness and education, the strengthening of environmental infrastructure and legislation, the protection of endangered terrestrial and marine resources, waste management and population planning are all seen as essential to the promotion of environmentally sustainable development on Nauru.

It must also be stressed that, while some programs and activities will require outside funding and expertise, some can be implemented immediately by government or by the local community or individual landowners and citizens. For each program, an attempt has been made to identify the agencies that might be responsible for implementation, potential funding sources, sources of expertise and to outline the nature of program.

The Objectives and Programs suggested under the National Environmental Action Plan include:

1. **LAND REHABILITATION AND PROTECTION**, including the rehabilitation of the mined-out phosphate lands, a rehabilitation trial, soil manufacture, and erosion assessment and control**.**

2. **STRENGTHENING ENVIRONMENTAL EDUCATION**, including the development of a Master Environmental Education Plan, the establishment of an Environmental Education Sub-committee and an Environmental Resource Centre, a traditional environmental awareness campaign, a "Keep Nauru a Pleasant Island" competition, an "Enviro-Media" campaign, a pilot "Operation Clean-Up Nauru" campaign, the upgrading of science education, and tertiary training in environmental science and environmental management.

3. **STRENGTHENING ENVIRONMENTAL INSTITUTIONS AND LEGISLATION**, including the establishment of a Nauru Environmental Coordinating Committee, adoption of the environmental impact assessment (EIA) process, development of a land use planning system, land tenure reform, conduct of relevant environmental baseline studies, establishment of a Nauru Environmental Information System, review and enforcement of existing legislation, and enactment of new environmental legislation.

4. **CONSERVATION OF BIODIVERSITY** including the survey and selection of priority conservation sites, establishment of pilot Conservation Areas under the SPBCP, protection and rehabilitation of endangered plants and animals, a noddy bird population biology study and conservation initiative, the development of a Forestry and Agroforestry Development Plan, establishment of a nursery system for endangered and culturally-important plants, establishment of a Rehabilitation Nursery, and the establishment of a Nauru National Botanical Garden and Arboretum.

5. **PROMOTION OF THE SUSTAINABLE USE OF MARINE RESOURCES**, including the establishment of marine reserves, improvement of the fisheries resources data base, control of overexploitation of marine resources, improved exploitation of pelagic and deepwater marine resources, reinstitution of appropriate traditional marine resources management strategies, and rehabilitation of aquaculture in Buada Lagoon.

6. **PEST AND DISEASE CONTROL** including the establishment of an Integrated Pest and Disease Control Program and a Quarantine Service.

7. **POLLUTION AND WASTE MANAGEMENT** including the development of an Integrated Waste Management Plan and the establishment of a Waste Management Authority, a waste reduction campaign, an education program for the safe handling and proper disposal of pesticides and chemicals, strengthening of recycling capabilities, green waste recycling, establishment of a sewage treatment plant, a composting toilet trial, air pollution monitoring and control, and noise pollution control.

8. **CONTROL OF POPULATION AND URBAN GROWTH** including the implementation of an effective family planning program, development of new residential and agricultural areas as part of the rehabilitation of Nauru, and controlling immigration into Nauru.

9. **HEALTH AND NUTRITION IMPROVEMENT** including a Health and Nutrition Awareness and Improvement Campaign and a Physical Fitness Campaign.

10. **PROMOTION OF SUSTAINABLE ECONOMIC DEVELOPMENT** including the strengthening of local production systems, the development of a Tourism Master Plan, and the promotion of ecotourism.

11. **APPROPRIATE INFRASTRUCTURAL DEVELOPMENT** including the coordination of infrastructure and services planning, obtaining consensus agreement of landowners on the easement or right-of-way over private property for the installation and maintenance of essential services, design of an Energy Management Plan, development of a stormwater collection and disposal system that minimises erosion and maximises the recycling of water for irrigation, and the establishment of an integrated water conservation program.

12. **ADDRESSING AND PREPARATION FOR GLOBAL CLIMATE CHANGE AND SEA-LEVEL RISE** including a continuing strong commitment to international initiatives addressing global climate change and sea-level rise, development of an Integrated Coastal Zone Management and Coastal Protection Plan, coastal forest protection and reforestation, and protection from ultraviolet radiation.

13. **MAINTENANCE OF A STRONG ANTI-NUCLEAR STANCE** including a continued commitment to all international anti-nuclear initiatives and the initiation of a local nuclear awareness campaign.

14. **MAINTENANCE OF A STRONG STANCE AGAINST TRADE IN TOXIC AND HAZARDOUS WASTES** including support of regional initiatives to ban the importation of hazardous and radioactive wastes.

SUMMARY AND CONCLUSIONS

The final chapter is a statement of Nauru's commitment to environmentally and culturally sustainable development and its resolve to proceed with the rehabilitation of the mined areas, while at the same time implementing the Environmental Action Plans as a means of providing a quality life for future Nauruans.

CHAPTER 1
INTRODUCTION

With a land area of only 22 km2 and a population of about seven thousand Nauruans, the Republic of Nauru is one of the smallest independent Nations in the world. At the time of first European contact in the 19th century, when sailing vessels stopped for provisions, Nauruans had lived a sustainable lifestyle on their island for some three thousand years. Subsequent to European contact, their distinct culture and their island were subjected to a succession of colonial regimes and serious exploitation and degradation. The expansion of coconut monoculture during the colonial period, widespread destruction and displacement of people during World War II, and almost a century of open-cast phosphate mining have made the island one of the most environmentally degraded areas on earth.

In 1968, Nauru became the independent Republic of Nauru. Phosphate mining continued under the government-run Nauru Phosphate Corporation. The income derived from the mining of phosphate has enabled Nauru to be fiercely independent, and to manage its own economy without external aid from developed countries - a situation unique in the Pacific. This independence is evidenced in the very strong stand Nauru has taken in the international arena with respect to environmental issues. Nauru was, in fact, the first signatory to the Climate Change Convention at Vienna in 1985. In an address to the Alliance of Small Island States (ASIS) in 1994, Nauru's President Bernard Dowiyogo stated that:

> . . . development should be aimed at living our own preferred ways of life in a clean and sustainable environment. Development must not ride the cultural and spiritual integrity of our peoples . . . we see development as a process of guided change directed toward our preferred goals. A healthy environment, which is our responsibility to ourselves and our children, is also the cornerstone of the process of sustainable development.

It can be seen that official concern for the environment and sustainable development is high on Nauru's agenda. Although Nauru has not yet announced a comprehensive policy on the Environment, it is a signatory to many international environmental treaties, conventions and agreements, and has shown strong and continuing support for the South Pacific Regional Environment Programme (SPREP)'s efforts to achieve economies of scale in addressing environmental issues and strengthening environmental capacities in the Pacific Islands. The Government's deep interest and concern in this area will no doubt provide a guide for the development of internal policy in this regard.

Most recently, in 1994, subsequent to a Deed of Settlement with Australia, a Nauru-Australia Cooperation Rehabilitation and Development Feasibility Study (NACRDFS) was undertaken to produce a blueprint for the rehabilitation of Nauru's mined-out lands. The terms of reference for rehabilitation include residual mining, pinnacle removal and crushing, the economical use of pinnacle rock and aggregate, reforestation, agricultural development, environmental protection, housing, and human resources development. In September, 1994, the Project team submitted their final Report in seven volumes. These volumes have provided a

great deal of information about Nauru's physical and biological environment, and have proposed a detailed series of recommendations to carry out the rehabilitation of post-mining Nauru. The information and ideas expressed in these volumes are acknowledged, and have been drawn on heavily in the preparation of this National Environment Strategy (NEMS).

Given Nauru's continued official support for regional and international environmental initiatives and the recent completion of the NACRDFS plan for the rehabilitation of the mined area, the preparation of this National Environmental Management Strategy (NEMS), which attempts to addresses all of the issues related to environmentally sustainable development on Nauru, is particularly timely.

1.1 THE PURPOSE OF A NATIONAL ENVIRONMENT MANAGEMENT STRATEGY

Although phosphate mining has brought great economic benefits to both Nauru as a nation and to Nauruan landowners, it has been at great environmental cost. Other types of development, increasing population pressure and urbanisation have also had negative impacts on Nauru's environment and people. The importance of protecting the environment and Nauru's renewable natural resources is made more urgent by the fact that the mining of phosphate, as a non-renewable capital resource and a source of income, will probably cease shortly after the turn of the century. With the cessation of new phosphate income, development efforts must refocus on:

1. Living off of the interest of the invested capital gained from phosphate mining;

2. The rehabilitation of the mined lands under the Nauru-Australia Cooperation Rehabilitation and Development agreement;

3. The protection, enhancement and sustainable use of renewable terrestrial and marine resources; and,

4. The promotion of environmentally friendly industries such as small-scale agriculture and tourism that can provide new sources of income in post-mining Nauru.

Environmentally sustainable development will require that economic development and environmental protection go hand in hand. On one hand Nauruans desire those services and technologies from the urban-industrial world that can make life on Nauru safer, healthier, more productive and more enjoyable. On the other hand, they will need to protect their environment, their renewable resources and their cultural traditions as the development capital needed for future generations. Essential ecological processes and life-support systems will need to be maintained, and plant and animal diversity preserved. Cultural traditions of sharing and caring, family solidarity and health, caring for ancestral lands and passing on traditional knowledge of their terrestrial and marine resources must be preserved and reinforced.

The purpose of this National Environment Management Strategy (NEMS) is simply this - to provide a plan to facilitate the integration of environmental concerns into the ongoing development planning and implementation processes so that Nauru's environment, renewable resources and treasured cultural traditions are protected as the capital needed for sustainable development. Nauruans lived sustainably for more than three thousand years based on their traditional principles of husbanding their natural resources as the capital needed for the development of future generations. They traditionally knew how to survive for the long term, and that is what sustainable development is all about. This NEMS seeks to take both traditional and scientific knowledge about Nauru's environment, and blend it with appropriate modern technology and common sense, to yield an action plan, with supporting strategies, programs and activities which can be used to promote environmentally sustainable development in Nauru.

1.2 SCOPE OF THIS NEMS

Like NEMS that have been prepared for other Pacific Island nations, this Nauru NEMS should be viewed as only a vital first step in identifying appropriate issues and strategies for promoting environmentally sustainable development in Nauru. As circumstances change, so will the priorities for implementation of different programs and activities. For the time being, the issues that are currently of greatest concern to Nauruans have been addressed. New issues will no doubt arise, and existing ones become less urgent. Whatever changes occur, the central principle of environmental sustainability will always apply.

There were four guiding principles for the preparation and implementation of the NEMS, that will, hopefully, ensure it's workability and success. These were:

1. That there must be an exhaustive, and continuing, process of consultation and consensus building;

2. That the NEMS must be based on what is currently known about the environment, and equally importantly, what is not known;

3. That priorities, the formulation of policy, and the resultant "environmental action plan", as the most important component of the NEMS, should depend on the results of the first two stages; and,

4. That the implementation of programs and activities suggested in the NEMS be constantly monitored, modified or changed over time based on both changing priorities of the Nauruan people and on the acquisition of new information or feedback on existing programs or activities and the state of Nauru's environment.

1.2.1 Consultation and Consensus-Building

Any successful NEMS must have the consensus support of the government and the community. To ensure that long-term results are maintained, individual public servants and others will be expected to carry out programs of work to achieve objectives that a wide

cross-section of citizens must understand and support. People will respond best to change when responding to something they understand, and something in which they have had an opportunity to participate. Coping with change requires an active stance, being able to recognize the possibilities for the future, and seeing where individuals can do something themselves, and fit into an overall plan. This requires knowledge that can only come from being involved in discussions and decision-making processes.

It is therefore imperative that a program of discussion with the public and special interest groups be organized and undertaken by the Nauru Environment Coordinating Committee (NECC). During the preparations for this report, some groups suggested that the traditional District Meeting format would be a promising forum for discussion at the community level. District representatives could then convey issues and priorities from their neighbors to the national level and, in turn, carry back information from that forum.

1.2.2 Information on the Environment

For environmental plans and strategies to be realistic, they must be based on known facts. In this regard, it is the function of this report to summarize the existing information on Nauru's people, economy, natural resources and state of the environment.

As stated above, the NACRDFS reports summarized much of the known scientific information on Nauru's land environment. Much of this information is summarized in Chapter 2 of this document. Information is also included on the marine environment and, in particular, the off-shore fishery. At the National level, it is felt that the land environment has been reasonably well researched and understood, although additional detailed studies may be required for some programs. There is however very little information available about the inshore fishery and the fringing reef. There is a need for surveys of these resources.

Unfortunately, most information about Nauru's resources is not readily available to most people. It is suggested that a booklet be prepared that summarizes these data. This would provide a valuable aid to the consultation and consensus-building process, for those who do not have access to the NEMS or the NACRDFS reports.

1.2.3 Policy Formulation

Policy formulation and the suggested Environmental Action Plan of programs and activities contained in the NEMS must be clearly based on: 1) the results of consultations with the people and policy makers of Nauru, 2) an examination of the information that is currently available on Nauru's environment, the impacts of past, current and proposed development on the environment, and, 3) the nature of current government policy and priorities. It must not be forgotten that programs and activities must also take into account the likely effects on social and economic agendas. That is not to say that the latter should dictate policy altogether, but rather that a parallel process of consideration should occur.

1.2.4 Need for Monitoring and Flexibility

Because no one can say for sure what the short- and long-term economic, political and environmental future of Nauru will be, as an independent small-island nation, for the Pacific Islands as a region, or for the entire Earth, needs and priorities will undoubtedly change as programs and activities are implemented and more complete information becomes available to the decision makers. There will, thus, be a need for the constant monitoring, modification and change of programs and activities suggested in the NEMS. Changes and modifications to activities must be based on the acquisition of new information or feedback on existing programs or activities and the state of Nauru's environment. This can only be done through a systematic monitoring of ongoing activities, continuing consultation with all parties concerned, and the continued acquisition and updating of required scientific information on the state of Nauru's environment. Such information must then be carefully considered and appropriate modifications made to ongoing programs and policy, possibly by the National Environmental Coordinating Committee (NECC).

1.3 ENVIRONMENTAL ACTION PLAN AND IMPLEMENTATION

This NEMS presents a National Environmental Action Plan (NEAP) and a range of programs and activities which can serve as a basis for the promotion of environmentally sustainable development. The recommendations and views expressed should be only taken as possibilities - as suggestions that need to be ratified and continually discussed by Nauru's people and their Government. The program of implementation will rely on a focussed and comprehensive Environmental Policy as ratified by the Government and the Nauruan people.

The NEAP contains a large number of individual programs and activities designed to address many different environmental issues. These programs and the issues they address will have different priorities for different groups. As a result, there will difficulty in prioritising different activities for implementation. In many cases, funding will need to be identified before meaningful work can be undertaken. This will prove an obstacle for some projects. Nevertheless, external sources may be approached to provide sponsorship, and the NECC will hopefully be able to undertake an assessment of these possibilities. SPREP, for example, could fund conservation area development under its South Pacific Biodiversity Conservation Programme (SPBCP), whereas some activities can be implemented by local communities themselves or non-government organisations (NGOs), and other can be implemented by the government, without significant additional funding, as part of its ongoing sectoral development activities.

CHAPTER 2

THE NAURU ENVIRONMENT

This chapter provides a description of the physical, biological and cultural environment of Nauru. It constitutes a "State of the Environment Report" for Nauru which can serve as a basis for policy formulation and prioritisation and the identification of types of information that still need to be gathered or updated.

2.1 THE PHYSICAL ENVIRONMENT

2.1.1 Geographical Location

The Republic of Nauru is an isolated, uplifted limestone island located 41 km south of the equator at 0^o 32' S. latitude and 166^o 56' E. longitude. It is some 2000 km east-northeast of Papua New Guinea, 4450 km south-southeast of the Philippines and an equal distance to the southwest of Hawaii. The nearest island is Banaba (Ocean Island), 300 km due east, which is part of the Republic of Kiribati. The Gilbert Islands, the main islands of Kiribati, lie a further 400 km to the east.

2.1.2 Topography

The total land area of Nauru is only 22 km^2 (2,200 ha). The island is surrounded by a fringing coral reef between 120 and 300 metres wide. The reef drops away sharply on the seaward edge, at an angle of about 40^o, to a depth of about 4000 metres. The land area consists of a narrow coastal plain or "Bottomside", ranging from 100 to 300 m wide, which encircles a limestone escarpment rising some 30 m to a central plateau, known locally as "Topside".

The coastal plain is comprised of a zone of sandy or rocky beach on the seaward edge, a beach ridge or foredune, behind which are either relatively flat ground or, in some places, low-lying depressions or small lagoons filled by brackish water where the surface level is below the water table (freshwater lens). The most extensive system of these landlocked lagoons is found near the border of Ijuw and Anabar Districts. Scattered limestone outcrops or pinnacles can also be found on both the coastal plain and on the intertidal flats of the fringing reef, with particularly good examples in the Anibare Bay area.

The escarpment ranges in gradient from vertical cliffs to gradually-sloping areas of colluvial soil (deposits that accumulate on and at the base of slopes as a result of movement by gravity) interspersed with limestone outcrops and pinnacles.

The raised central plateau or Topside consists of a matrix of coral-limestone pinnacles and limestone outcrops, between which lie extensive deposits of soil and high-grade tricalcic phosphate rock (Tyrer 1963, Viviani 1970). This area covers approximately 16,000 ha (over 70% of the island) and has been the focus of phosphate mining for over 80 years. Relative

elevations on Topside vary generally between 20 and 45 m above sea level, with occasional pinnacle outcrops reaching elevation of 50 to a maximum of 70 m above sea level. The topography remaining after completion of primary phosphate mining is a pinnacle and pit relief varying between 2 and 10 metres from the top of the pinnacles to the bottom of the pits. The highest point on the island is Command Ridge in the west at an elevation of 71 m above sea level.

Buada Lagoon, a landlocked, slightly brackish, freshwater lake, and its associated fertile depression (about 12 ha in area), is located in the low-lying southwest-central portion of the island at an elevation of about 5 m above sea level.

2.1.3 Hydrology

Apart from Buada Lagoon, there are no surface freshwater resources on Nauru, although there are a few brackish ponds near the base of the escarpment, especially on the northeast of the island in Ijuw and Anabar Districts, and an underground lake in Moqua Cave in the southeast (Viviani 1970). The only significant permanent freshwater resource is groundwater in the form of a "lens" of often slightly brackish freshwater, hydrostatically "floating" on higher density saltwater beneath it. The height of the freshwater lens above sea level and the level of salinity vary in relation to the elevation, geology, texture and shape of the island, and with the amount of water use and rainfall.

A Hydrological study of Nauru was undertaken for the Commission of Inquiry in 1988 (Jacobson and Hill 1988). This indicated that groundwater exists in the form of a layer (head) averaging 4 to 5 m thick (above sea level), with the lens being particularly well-developed in the north-central and south-central parts of the island. Beneath the upper layer or head the water becomes increasingly brackish with depth until it meets salt water at 80 m below sea level. Replenishment or recharge of the freshwater lens is dependent on rainfall. A first approximation of the average groundwater recharge for Nauru is 800 mm per year (based on the following figures: rainfall (2000 mm) - evapotranspiration (1200 mm) = groundwater recharge (800 mm).

Groundwater on the bottomside is tapped by several hundred wells, about one-third of which exceed the W.H.O. recommended limit of 1500 mg/l Total Dissolved Solids. Groundwater under the topside area has been mathematically modelled, with the result that a sustainable bore field could comprise 4 bores at 1 km centres producing 1 litre/second and 4 bores at 1 km centres producing 2 l/second. Alternatively, bores could be spaced closer together but produce less water flow.

Jacobson and Hill (1988) also concluded that the collection and storage of rainwater should be a top priority. Long term potential threats to the quality of the groundwater resource included contamination by cadmium, rubbish dump leachate and sewage.

2.1.4 Geology and Geomorphology

Nauru is a raised coral-limestone island (formerly an atoll) underlain by a volcanic seamount that rises from the floor of the Pacific Ocean. The results of gravity and magnetic surveys indicate that about 500 m of dolomitised limestone caps the seamount. The limestone has been drilled to a depth of 55 m below sea level and is intensely karstified (the formation of many cavities, sinkholes and cave systems due to the breakdown of limestone in solution) to that depth, with phosphate filling the cavities.

Fossil pollen studies and dating techniques indicate that the limestone is of upper Miocene (5 million years) to Quaternary (0.3 million years) age at the depths tested by drilling. The volcanic seamount may be mid-Eocene (35 million years) in age.

Topography of the former atoll is discernible, with Command Ridge on the west side and patches of high ground on the south probably marking the original atoll rim. Traces of high ground (above 50 m) across the centre of the island may mark the line of the former reef. A major karstic subsidence feature forms the catchment of Buada Lagoon and may be the location of the former atoll lagoon.

The tricalcic phosphate capping of Nauru is several metres thick and overlies an intensely dissected limestone base with limestone pinnacles up to approximately 20 m high. The phosphate deposits also occupy the space between the pinnacles and infill caves and joints in the limestone.

Preliminary earthworks undertaken for the Commission of Inquiry in 1988 indicate that the pinnacles in some areas of sinkage appear to be "floating" (embedded) in the phosphate deposits, which may extend beneath them for some distance. Excavations were carried out to a depth of eight metres, with many "floating" coral-limestone boulders observed within a phosphate matrix, below the surface pinnacles. The depth and extent of these secondary phosphate deposits remain to be quantified (Drayton 1995).

2.1.5 Climate

Nauru is located in the dry belt of the equatorial oceanic zone, with diurnal temperatures ranging from 26^{o}C to 35^{o}C, and nocturnal temperatures between 22^{o}C and 28^{o}C.

Annual rainfall is extremely variable, averaging 2126 mm per year (data from 77 years between 1916 and 1993) with a range of 280 to 4590 mm. Monthly rainfall data available for the period 1977 to 1993 indicate a range of 0 to 746 mm, with 62 months out of 204 months (for which data were available) having less than 100 mm of rain. Rain tends to be more frequent during the months of December to April (data from Davey 1966 and NPC Analytical Laboratory Reports). Prolonged droughts are common and place severe stress on even the most hardy coastal strand species, lead to the death of non-coastal exotics (such as breadfruit), and severely restrict the production of even coconut palms. For example, in 1917 and 1918, when only 465 and 483 mm of rain fell, "thousands of coconuts and other fruit trees died" (Griffiths 1923).

The wind direction during the drier months from May to November is generally from the easterly sector at speeds of 5 to 10 knots, and during the wetter months from December to April is generally from the westerly sector at speeds of 10 to 18 knots. During squally weather wind speeds of up to 30 to 35 knots have been recorded. Nauru does not experience tropical cyclones.

2.1.6 Soils

The coastal soils of Nauru are only about 25 cm deep, are coarse textured and contain more coral gravel than sand in the lower horizons. Potassium levels are often extremely low, and pH values of up to 8.2 to 8.9 and high $CaCO_3$ levels make trace elements, particularly iron (Fe), manganese (Mn), copper (Cu) and zinc (Zn), unavailable to plants. Fertility is, therefore, highly dependent on organic matter for the concentration and recycling of plant nutrients, lowering soil pH, and for soil water retention in the excessively well-drained soils. Although levels of organic matter can be relatively high in undisturbed soils under natural vegetation, it can decrease dramatically as a result of clearance by fire or replacement by coconuts and other introduced plants (Morrison 1987).

The plateau soils of Nauru vary from shallow soils, on the tops of limestone pinnacles, composed primarily of organic material and sand or dolomite, with very little phosphate, to deep phosphatic soils and sandy phosphatic rock, up to over 2 m deep between the pinnacles. Topsoils range from 10 to 30 cm in depth, overlaying a deeper subsoil which is frequently reddish yellow and between 25 and 75 cm deep, changing to pinkish grey at greater depth. Undisturbed plateau soils have a high level of organic material and are generally fertile. Calcium dominates the exchange complex and exchangeable magnesium is also high. Exchangeable potassium is low, while extractable phosphate values are generally high and sulphate moderate. Levels of the trace elements manganese, copper, cobalt and molybdenum are very low, and these, plus iron and zinc, are rendered unavailable to plants under pH values greater than 6.5 (Morrison 1987).

The organic content of undisturbed soils is 1 - 11% on Topside and 0.1 - 1.9% on Bottomside. From the plant nutrition point of view, Morrison (1994) reports that nitrogen is sufficient for all but intensive agriculture, although potassium is generally low (and depressed by high levels of calcium). Expected trace element deficiencies include manganese, copper, cobalt and molybdenum. Iron, copper, zinc and manganese are likely to be unavailable to plants due to high pH values. Cadmium is present in the soil at high concentrations of 80 - 120 mg/kg, and needs to be monitored in plant products intended for human consumption.

Around Buada Lagoon and in some poorly drained swampy areas near the base of the escarpment on Nauru, there are poorly developed, but relatively fertile, wet (hydromorphic) soils.

2.2 TERRESTRIAL LIFE

2.2.1 Flora and Vegetation

The indigenous flora and the vegetation of Nauru are among the most limited on earth. Because of Nauru's small size, limited habitat diversity, and its physical isolation from the Asian continent and other islands, only 60 indigenous species of vascular plants (i.e. ferns, gymnosperms and flowering plants, and excluding non-vascular plants, such as mosses, lichens, etc.) have been recorded from the island (These are listed in Appendix 3). There are no endemic plants (plants unique to Nauru). Moreover, long settlement, widespread destruction during World War II, monocultural expansion of coconut palms, and over 80 years of open-cast phosphate mining have led to serious vegetation degradation, disturbance, and displacement.

The total number of vascular plants, including introduced species numbers over 500. The introduced species consist mainly of ornamentals, weed species, food plants, and a number of other useful cultivated plants. Although greatly outnumbered by exotics, the indigenous species still constitute the most culturally-useful and ecologically-important species. Due to the unique adaptability of indigenous Pacific island plants to the harsh conditions of coastal and small-island environments, and their cultural and ecological utility, their protection and enhancement are crucial as a basis for sustainable development on Nauru.

The main primary vegetation types are coastal strand vegetation, mangroves and coastal marsh vegetation, inland forest, and limestone escarpment or pinnacle vegetation.

The secondary (highly modified) vegetation types include coconut lands under various degrees of maintenance, urban gardens, ruderal vegetation along roadsides and in open lots and other disturbed areas on Bottomside, and a mosaic of various stages of natural regeneration in the mined areas on Topside.

Although it is true that the majority of Nauru is covered with vegetation of some kind, only about 364 ha or about 16.5% of the island's vegetation is dominated by indigenous species. It should be noted that although indigenous Topside *Calophyllum* (**iyo**) forest accounts for about 37 ha of this, it is destined to be mined unless protected in some way. Other indigenous, primary vegetation, such as small areas of mangroves and coastal vegetation, occupy only very small areas, or are represented by individual plants, and are in urgent need of conservation.

Out of Nauru's total area of 2,159 ha, 1,366 ha (63%) of the vegetation cover comprises regeneration after mining. This can be divided into the 211 ha that were mined more than 50 years ago, and the 1155 ha mined over the past 50 years. The latter areas were those mined by mechanical means, and which are now regarded as prospective areas for "secondary" mining (re-mining) of residual phosphate deposits.

The very tall closed forest around the Buada Lagoon area extends over approximately 68 ha, and is regarded as the best potential forestry conservation area in Nauru. This is one of the areas that was identified as a priority conservation zone in both the land use plan proposed in the NACRDFS report and in this NEMS.

Of the 61 indigenous species that make up Nauru's flora, seven are widespread tropical ferns or pteridophytes, and among the flowering plants, there are seven monocotyledons and 47 dicotyledons (Table 2.1).

Table 2.1. Antiquity status of the flora of Nauru in terms of whether species are presumed to be indigenous to Nauru; aboriginal or recent post-European-contact introductions; or now extinct.

Group	Indigenous	Aboriginal	Recent	Extinct	Total
Pteridophytes	7	-	3	-	10
Gymnosperms	-	-	2	-	2
Monocotyledons	7	1	139	-	147
Dicotyledons	47	3	282	8	340
Total	61	4	426	8	499

Indigenous monocotyledons are restricted to pandanus, **epo** (**epuh**) (*Pandanus tectorius*) and probably the coconut palm, **ini** (*Cocos nucifera*), cultivars of both which are undoubtedly aboriginal introductions, and a small range of sedges and grasses (Cyperaceae and Poaceae), some of which might be aboriginal or recent introductions. The grass *Stenotaphrum micranthrum* (reported present by Fosberg *et al*. 1987) is considered to be endangered or now absent.

The indigenous dicotyledons consist almost exclusively of salt-tolerant, widely-dispersed, pantropical coastal species. Of the 47 herbaceous and woody dicotyledons, half (23) are endangered or rare (Appendix P). Species such as *Boerhavia repens*, *Heliotropium procumbens*, *Laportia ruderalis*, *Triumfetta procumbens*, *Abutilon asiaticum*, *Caesalpinia bonduc*, *Euphorbia chamissonis*, *Sida fallax*, *Suriana maritima*, *Aidia cochinchinensis*, *Barringtonia asiatica*, *Cerbera manghas*, *Erythrina variegata*, *Hernandia nymphaeifolia*, *Neisosperma oppositifolium*, *Pisonia grandis*, *Rhizophora apiculata*, *Thespesia populnea* and *Vitex negundo* are represented by only a few remaining individuals, often in houseyard gardens, or by localised relict communities. Prior to widespread disturbance, Nauru would have undoubtedly had more species than it has at present.

Exotic (introduced) species, which constitute 88% (438 out of a total of 498 reported species) of the flora of Nauru, dominate ruderal, houseyard and urban vegetation, and include a wide range of ornamentals, weedy species, food plants and a number of other useful species.

Ornamentals, which are normally confined to houseyard and village gardens, comprise some 60% (261) of the 438 exotic species. On Nauru, introductions by travellers from Australia, Fiji and other areas with highly developed ornamental gardening traditions; the absence of quarantine restrictions; and the almost total breakdown in the subsistence

economy, seem to be the main reasons for the disproportionate importance of ornamental plants. Some of these ornamentals, of course, have other uses such as living fencing or for the preparation of medicines or garlands.

The proportions of the exotic flora composed of weedy species is about 18% (80 of 438 species), an indication of both the poverty of the indigenous flora and the highly disturbed nature of the vegetation.

Although food plants represent 16% of the exotic flora, due to the harsh environment, limited land area and limited focus on food production in Nauru, many of these species are restricted in numbers or utility and are often represented by experimental attempts to diversify food production or by individual, often immature specimens of a given species.

Food plants of particular importance on Nauru include numerous edible pandanus and coconut cultivars, some of which are undoubtedly aboriginal introductions, and breadfruit and bananas. Recent introductions of more localized importance, or of particular importance to contract worker communities on Nauru include: the vegetables, hibiscus spinach (*Hibiscus manihot*), Chinese cabbage cultivars (*Brassica* spp.), long beans (*Vigna sesquipedalis*), amaranth spinach (*Amaranthus* spp.) and pumpkin (*Cucurbita pepo*); the staple root crops, taro (*Colocasia esculenta*), tannia (*Xanthosoma sagittifolium*), sweet potato (*Ipomoea batatas*) and cassava (*Manihot esculenta*); a range of banana and plantain cultivars (*Musa* cultivars); and the tree crops, lime (*Citrus aurantifolia*), guava (*Psidium guajava*), mango (*Mangifera indica*), soursop (*Annona muricata*) and the horseradish or drumstick tree (*Moringa oleifera*), all of which seem to do well in Nauru's harsh environment. Important emergency or pig foods include Polynesian arrowroot (*Tacca leontopetaloides*) and purslane (*Portulaca oleracea*), both of which are found occasionally as naturalised plants in the coastal vegetation or in ruderal sites.

Other useful exotic species include kapok (*Ceiba pentandra*), cotton (*Gossypium barbadense*), tobacco (*Nicotiana tabacum*), and bamboo (*Bambusa vulgaris*), which were all reportedly more abundant in the past. As suggested above, some larger weedy exotics, such as *Adenanthera pavonina*, *Annona* spp., *Casuarina equisetifolia*, *Lantana camara*, *Leucaena leucocephala*, *Mangifera indica*, *Muntingia calabura* and *Psidium guajava* have become naturalized and competitive with the indigenous species in some disturbed and relatively undisturbed sites.

2.2.2 Ecological and Cultural Importance of Nauru's Plants

Although highly disturbed, outnumbered and, in some ways, "enriched" by introduced exotics, the vegetation and flora of Nauru still constitute a critical ecological and cultural resource to the people of Nauru. This is particularly true for the indigenous species, virtually all of which had wide cultural utility within the traditional subsistence economy.

The most important ecological functions of Nauru's plant resources include the provision of shade to humans and animals, animal and plant habitats, protection from wind, erosion, flood and saltwater incursion, land stabilization, protection from the desiccating

effects of salt spray, soil improvement and mulching. All of these functions are seen as critical to the sustainable habitation of Nauru. Shade, for example, will be of increasing importance given the predicted increases in cancer-causing ultraviolet light due to the breakdown in the Earth's protective ozone layer. Similarly, if forests and trees are not protected, noddy bird hunting may become a thing of the past, and coastal erosion may render some coastal sites uninhabitable.

In terms of more strictly cultural utility, preliminary analyses indicate 174 purposes or use categories for 40 indigenous species, an average of over four uses per species. There are 434 uses for 354 exotic species, an average of 1.2 uses per species (Table 2.2). This gives a combined total of 608 use/purpose categories for 394 species (1.5 uses per species). Twenty (20) indigenous and 80 exotic species had no reported uses. The relative importance of the indigenous flora would undoubtedly be much more pronounced if: 1) a more systematic in-depth survey of the cultural utility of each indigenous species had been conducted; 2) Nauru had not experienced such widespread devastation of its population, traditional economy, traditional education system and its indigenous flora (and associated ethnobotanical knowledge) over the past 100 years; and 3) planted ornamentals, by far the most widespread use of exotic species, were excluded from the analysis of indigenous species (Thaman *et al*. 1994).

Table 2.2 Frequency of use for specified purposes of plant species present in Nauru (Note: Introduced includes both aboriginal introductions such as coconut and recent post-European-contact introductions).

Purpose/Use	Indigenous x/60	Introduced x/434	Total x/494
Cultivated Ornamentals	9	257	266
Food Plants	2	64	66
Body Ornamentation	16	23	39
Medicinal/Health	18	13	31
Staple Foods	1	13	14
General Construction	12	2	14
Scenting Oil/Perfumery	6	7	13
Firewood/Fuel	7	4	11
Emergency/Famine Foods	3	6	9
Tools/Utensils	8	1	9
Boat/Canoe Building	8	-	8
Handicrafts	7	1	8
Games/Toys	6	1	7
Food Parcelisation	5	2	7
Living Fences/Hedges	1	6	7
Cordage/Fibre	3	3	6
Hair Conditioner	6	-	6

Woodcarving	5	-	5
Adhesive/Glue/Caulking	1	4	5
Earth Oven Cover	5	-	5
Magic/Sorcery	4	-	4
Drinks/Beverage	-	4	4
Fishing Equipment	3	2	5
Clothing	3	1	4
Animal Feed	2	2	4
Plaited Ware	3	1	4
Legends/Mythology	2	1	3
Furniture	3	-	3
Animal Cages/Roosts	1	2	3
Fish Poisons	2	-	2
Fire by Friction	1	1	2
Strainers/Filters	1	1	2
Thatching/Roofing	1	1	2
Dyes/Pigments	2	-	2
Nets/Traps	2	-	2
Fans	1	1	2
Chewing Gum/Masticants	-	2	2
Oils/Lubricants	1	1	2
Corks/Stoppers	1	1	2
Other Uses*	12	6	18
TOTAL	174	434	608
NO USES	20	80	100

* Other uses include aphrodisiacs, appetite stimulants, brushes, toilet paper, illumination, soap/shampoo, containers, deodorants/air fresheners, fishnet floats, green manure, groundcover, meat tenderizer, insect repellents/fumigants, love potions, wild animal food, fishing bait, cigarette wrappers and tobacco.

Moreover, if distinct uses within use/purpose categories (e.g., tools with distinct functions, different types of fishing equipment, foods or ornamentation for different occasions or purposes, medicines for different ailments, or plants used for specific parts of boats or houses) are counted, the economic and cultural utility of plants becomes even more pronounced. The coconut palm, **ini** (*Cocos nucifera*), for example, has 33 reported uses in Nauru, almost undoubtedly a gross underestimate, in light of at least 128 reported uses (many of which are almost ubiquitous) for the coconut palm throughout the Pacific Islands (Thaman 1992ab). Next in order of importance, are 19 species, all with 5 or more reported uses. These include, in order of importance, **ekwane** (*Hibiscus tiliaceus*), **epo** (*Pandanus tectorius*), **emet** (*Scaevola taccada*), **deneno** (*Morinda citrifolia*), **yut** (*Guettarda speciosa*), **iyo** (*Calophyllum inophyllum*), **eowongo** (*Cordia subcordata*), **etetah** (*Terminalia catappa*), **deme** (*Artocarpus altilis*), **itirya** (*Thespesia populnea*), **irin** (*Tournefortia argentea*), **idibinerr** (*Premna serratifolia*), **ikiow** (*Triumfetta procumbens*), **dagaidu** (*Vitex negundo*), **eorara** (*Ochrosia*

elliptica), **denuwanini** (*Cassytha filiformis*), **dabanana** (*Musa* cultivars), **ebarabaratu** (*Bambusa vulgaris*) and **dababaia** (*Carica papaya*). Of these 20 species, *Artocarpus altilis*, *Musa* ABB Group, *Bambusa vulgaris* and *Carica papaya*, are aboriginal or recent introductions.

Another 13 species, 7 of which are indigenous, **eteweau** (*Dodonea viscosa*), **etsiu** or **yetiu** (*Hernandia nymphaeifolia*), **demeria** (*Plumeria rubra*), **kuwawa** (*Psidium guajava*), **yoreh** (*Erythrina variegata*), **etum** or **etam** (*Bruguiera gymnorrhiza*), **kwenababai** (*Barringtonia asiatica*), **erekogo** (*Vigna marina*), **eyamwiye** (*Clerodendrum inerme*), **tiare** (*Gardenia taitensis*), **rimone** (*Jasminum sambac*), **dagiebu** (*Crinum asiaticum*) and **darot** (*Hibiscus rosa-sinensis*), have at least 3 uses each. Although, there is some usage overlap between categories, such as supplementary and emergency foods, medicinal, magical, ceremonial and body ornamentation plants, or plants used for handicrafts, woodcarving, cordage and clothing. Conversely, the categories could be further broken down to yield an even greater list of uses. Moreover, the list does not include the more strictly ecological functions of coastal plants, such as shade, protection from wind, sand and salt spray, erosion and flood control, coastal reclamation, animal and plant habitats, and soil improvement, all of importance, particularly on an ecologically devastated post-mining Nauru.

2.2.3 Effects of Introduced Plants as Weeds

Recent observations at Anibare and Buada have indicated that indigenous species may be experiencing increasing competition from introduced species, thus interfering with their regeneration. Given the low number of indigenous species compared with introduced species, their immense cultural, economic and ecological importance, and the proven aggressive and highly competitive nature of some of exotic species, there is a priority need for the protection and nurturing of native plants to ensure their future on Nauru. Examples include the replacement of indigenous species by **bin** (*Adenanthera pavonina*) in areas on the escarpment and around Buada Lagoon, and the spread of **magiroa** (*Lantana camara*) in some areas.

2.2.4 Terrestrial Fauna

Nauru's main indigenous land animals consist of birds, insects and some land crabs. Some of these constitute resources of considerable importance to sustainable development, both in terms of their ecological and cultural utility and their possible importance to the development of National Reserves and a limited tourist industry. There are no indigenous land mammals on Nauru, with the Polynesian rat (*Rattus exulans*) being probably an aboriginal introduction. Other introduced rats, cats, dogs, pigs and chickens are common. Chickens are also common.

No information is available on reptiles, although geckos and skinks (*Gehrya* and *Emoia* species) are abundant. A Saltwater crocodile was found in Nauru in 1994, but subsequently died (in jail)! No amphibians have been recorded from Nauru. The coconut crab (*Birgus latro)* is apparently quite scarce, possibly due to overexploitation and habitat modification, and a range of other smaller land crabs are often observed among the pinnacles of the escarpment and on the coastal strip. Some collecting of invertebrates has been carried out recently, with the identification of five species of fruit fly (*Bactrocera*) (NIC Annual Report, 1993).

Birds, most of which are either sea birds or migratory species, constitute the most visible and among the most culturally important indigenous animals of Nauru. Migratory species use the island to stop and feed, and sometimes to breed and nest, although habitat disturbance has reduced the incidence of such species. Pearson (1962) recorded 25 species of birds on Nauru, including nine species resident all year, but not necessarily breeding, nine passage migrants and vagrants, six winter residents present during the non-breeding season, and one unconfirmed record, the sacred kingfisher (Pratt, Bruner and Berrett 1987)(see Appendix 4). The single species regarded as endemic is the Nauruan Reed Warbler or Nauru Canary (*Acrocephalus rehsei*). Brown and black (white-capped noddies)(*Anous stolidus* and *Anous minutus*, respectively), common fairy terns (*Gygis alba*) and the great frigate bird (*Fregata minor*) are all culturally important.

2.3 MARINE LIFE

Despite the limited extent of its coral reefs, intertidal zone, and its 200-mile Exclusive Economic Zone (EEZ), Nauru has a relatively rich marine biota. The main categories of marine resources include a wide range of finfish and a more limited range of turtles, crustaceans, octopus, shellfish, holothurians (beche-de-mer), other invertebrates and algae. Based on the number of species around nearby islands, Nauru is estimated to have between 300 and 500 finfish species alone (Appendix 5 is a listing of over 100 of the more common species).

Nauru's main fisheries zones are: 1) the fresh to brackish water ponds, including Buada Lagoon and the systems of sinkholes found inland from the coast; 2) the shallow fringing reef or intertidal zone; 3) the subtidal areas and reef slope including fissures or canyons in the reef slope (to about 25 m depth); 4) the deep reef and near-shore deepwater areas below 25 m; and 5) the open ocean or pelagic fishery. All of these areas are of critical

subsistence importance, as well as being of limited local commercial importance. The first four zones are usually considered to be part of the inshore fishery and the latter being referred to as the offshore fishery.

The resources of zones 1 to 3 are heavily exploited, and the deep reef and deepwater nearshore areas are being increasingly exploited due to SCUBA spearfishing. Most of the potential for increased commercial catches is therefore from deep water off-shore species (snapper and sharks) and pelagic species (mainly tunas) in Nauru's EEZ, which has an area of approximately 320,000 km^2. There is also limited potential for strengthening the aquacultural production of milkfish or tilapia in the brackish water ponds.

2.3.1 Fishing Techniques

The main fishing methods consist of: 1) reef gleaning at low tide in the intertidal zone; 2) the use of gill nets, encircling nets and scoop nets for catching mullet, milkfish, flyingfish and other species; 3) limited use of throw-nets on the fringing reef; 4) shallow and deep water spearfishing, with and without SCUBA tanks; 5) handlining, poling and trolling for small surf-fish, deepwater snappers, tunas and other pelagic species; and 6) deepwater handlining, primarily for oilfish, which is also carried out at night in depths of up to 150 m. Within these categories fishermen have developed many specialised techniques involving different types of nets, hooks and lines, baits, lures, spears, traps and fences, poisons and gleaning strategies. Most notable are underwater line-fishing techniques using bamboo or hibiscus (**ekwane**) poles, known as **krebab** and **akida**, respectively, and the multi-line, multi-hook "Christmas tree" fishing method from small canoes. Also very important in the past were **enge**, carefully constructed piles of rocks and coral, which served as fish aggregation areas or traps from which fish could be easily harvested. **Enge**, which were also a means of designating ownership of fishing areas on the intertidal zone, are now uncommon or not respected by non-Nauruans or the younger generation, a trend which constitutes a breakdown in an important fisheries management practice.

Whereas most Nauruans use outboard powered craft to fish outside the reef slope, often going 10 to 20 km offshore, out of sight of the island, other Pacific Islanders (mainly I-Kiribati and Tuvaluans) fish mainly from small traditional, non-motorised canoes. The more modern local artisanal fishermen use improved tackle, boats, nets and ice boxes.

A number of fish aggregation devices (FADs) have been deployed in the past to increase both subsistence and commercial catches. Although these no longer remain, there are plans to install a series of new improved FADs that are less susceptible to damage or removal.

Milkfish aquaculture has been traditionally practised in Buada Lagoon area by families who had no sea frontage nor fishing rights. Milkfish (ibiya) fry from the ocean were acclimatised and then raised in the brackish waters of Buada lagoon which was divided by coconut form curtains into individual family aquacultural areas. Competition from the introduced tilapia (*Oreochromis mossambica*) has, however, had a negative impact on the traditional system, and recent attempts to remove the tilapia have proved unsuccessful,

resulting in a mixed culture. It may be that the best solution is to accept the existing tilapia, but introduce new improved varieties for their improved performance and edibility.

2.3.2 Finfish Resources

The most important finfish species for subsistence and local sale in Nauru include: shallow- and deep-water snapper, rockcod, grouper, or coral trout species (**eanape**, **eanurum**, **earata**, **earo**, **eaurur**, **etom**, **ianen**, **ianit**, **iniame**, **iwuro**, **kawudo**); squirrelfish (**eabanginab**, **ebo**, **egarokoa**, **emwan**; milkfish (**ibiya**); mullets (**eaiar**, **eaor**, **ekiakuo**); surgeonfish or tangs (**deiboe**, **dereba**, **eweo**, **iwiyi**, **yab ereber**); trevally or jacks (**apwe**, **doruwa**, **eaeo**, **kwidada**); drummers (**ebawo**, **iyibawo**); scads (**ikuri**); goatfish (**dorangarang**); garfishes (**ekadawea**) and the larger deepwater or pelagic species including tunas (see list below); sharks (**degoriria**, **ebawo kumo**, **egop**, **eimar**, **ierangue**); barracudas and seapikes (**degabouwa**, **etaro**); billfish (**iyubur**, **iriname**, **iubur**) and flying fish (**emorr**)(see Appendix 5 for a complete list arranged alphabetically by Nauruan name). These species comprise the bulk of the subsistence and artisanal catch in Nauru. It is of interest to note that although there may be a number of Nauruan names for a group of fish, the same name may be applied to two or more biological species. The scientific names will therefore need to be used in assessing the conservation status of the finfish species.

Another nine groups of secondary importance include parrotfishes (**earamai**); rabbitfish or spinefoot (**eokong**); emperors or breams (**eaouna**); snake mackerel (**ieru**); stingrays (**debagommaroa**); moray eel (**yamit**, etorobwiy); lunar-tailed cod (**erenai**); unicornfish (**irer**, **kiyoyo**); oilfish (**eaeokwor**); and longtom (**iuiuj**), all of which are food fishes

The pelagic tunas of increasing export and local commercial importance include: skipjack tuna (**eae**), yellowfin tuna, bigeye tuna, albacore tuna, and dogtooth tuna (all **itsibab**).These species are of particular importance to the fleet of more than 300 small, mostly non-motorised, boats owned by the I-Kiribati and Tuvaluans who fish both for subsistence and for local sale. Skipjack and yellowfin stocks seem to be sufficient to sustain both a substantial commercial off-shore fishery and the existing subsistence and artisanal fisheries. Other pelagic species include bigeye scad (**iquri**), rainbow runner (**eokwoy**), mackerel tuna (**edowedowa**), wahoo (**egow**), and dolphin fish or mahimahi (**eaywiwi**).

Nauru shares it's tuna resources with most other Pacific Island countries. This resource is the largest fishery in the Pacific Islands area, where approximately 1 million tonnes pre annum of skipjack, yellowfin, bigeye, and albacore are caught by purse seine, longline, and pole/line gear. Although Nauru's 200-mile economic zone is relatively small, it is well placed for tuna fishing, being both endowed with logs from the large islands from the west, and situated in the middle of the western purse seine grounds (PNG/FSM in non-El Nino years), and the eastern grounds (Gilberts/Phoenix/Line in El Nino years).

Deepsea demersal species of increasing commercial importance include jobfish (*Aphareus* spp.) and the deepsea snappers (*Aprion*, *Etelis*, *Gnathodentex*, *Paracaesio*, *Pristipomoides* and *Tropidinus* spp.). There is some potential for the exploitation of these

species, based on the use of the 200 m isobath as an indicator of available resources, which extends for about 19 km (10.3 nautical miles) around Nauru. The South Pacific Commission, which has fostered the development of the deep bottomfish fishery in most other Pacific Island countries, has not received a request to do so on Nauru. However, based on the length of the 200 m isobath, the estimated maximum sustainable yield of bottomfish on Nauru to be between 250 and 750 kg per year, a fairly small quantity (Dalzell and Preston 1992).

2.3.3 Non-Finfish Resources

Both the hawksbill and green turtles (*Eretmochelys imbricata* and *Chelonia mydas*) are occasionally present, but rarely seen in Nauru. Some beaches were reportedly once nesting areas, although this is no longer the case.

Crustacean catches are generally minimal and primarily for subsistence purposes. Lobster (*Panulirius* spp.) is highly sought after, but increasingly rare. There is a number of crab species, although the coconut crab (*Birgus latro*), which has been reported, has not been seen for some time, and may be extinct on Nauru.

Of the shellfish, the only widely collected species is the rough turban shell or **emwari** (*Turbo setosus*) which is collected on the tidal flats of the fringing reef at low tide, usually by women. Less commonly found are mancinella rock shells (*Thais mancinella*) and frog shells (*Bursa* sp.) (both referred to as **igupwa**). Another species of **emwari**, the silver-mouth turban (*Turbo argyrostoma*) is found in deeper water in holes and crevices and under rocks on the outer reef and reef slope. The plicate nerite (*Nerita plicata*), which is common on shoreline rocks in the intertidal area, and a range of cowries (*Cypraea* spp.) are used occasionally for making shell necklaces. There is need for a systematic survey to inventory and study Nauru invertebrate inshore fauna.

Seaslugs or beche-de-mer (holothurians) are present in limited quantities in Nauru, since extensive reef flats and shallow lagoons are not present. The two main species identified during the NEMS study were the lollyfish (*Holothuria atra*), found in the intertidal zone, and the surf redfish (*Actinpyga mauritiana*) found in subtidal areas on the outer edge of the reef in the wave zone. Beche-de-mer were one of the first export products from the Pacific Islands after European contact, but they are not eaten in Nauru and are probably in insufficient quantities to warrant their exploitation for export. They are, however, eaten by some non-Nauruan contract workers.

A range of indigenous marine seaweeds or algae constitute an important nutritional and commercial resource in many areas of the Pacific, and although some of these are present, none are traditionally eaten in Nauru.

2.3.4 Status of Marine Resources

It can be seen from the above sections that there is a very wide and diverse range of marine resources available for sustainable harvest in Nauru. Many of these have helped

sustain the people of Nauru since their first arrival over three thousand years ago. The resilience of the resource is evidenced by the fact that, despite many years of daily reef gleaning, it is still possible for some families to glean their daily protein needs from the intertidal zone and fringing reef areas.

However, the increasing scarcity of many formerly more common marine organisms such as turtles, large reef cod, squirrelfish, drummers, and turban shells is well known. Smaller catches and decreasing average size of individuals are sure indicators that overfishing has occurred for these species. Of particular concern, is the fact that an increasing percentage of the overall catch is being sold commercially, thus applying more pressure on these resources. This situation underlines the need for protective legislation and sustainable harvesting strategies.

Fortunately, the conservation ethic remains strong among some Nauruans, and there are some traditional and modern conservation practices that could be used to protect the sustainablility of the resource. Some of the main mechanisms included secrecy about fishing grounds and techniques, temporary or seasonal taboos or bans on species or fishing grounds, restrictions on the consumption of certain species (e.g. some species such as turtles or giant clams were reserved for chiefs or priests), fines or penalties for resource abuses, and clan tenure or limited access to reef and lagoon areas.

2.4 CULTURAL ENVIRONMENT

2.4.1 The People and the Nauruan Culture

The indigenous people of Nauru are Micronesians, who have probably inhabited the island for up to 3000 years or more. There is some evidence of Melanesian, and possibly Polynesian, influence. The Nauruan language is quite distinct from all other Pacific languages, reportedly a fusion of elements from the Gilbert, Caroline, Marshall and Solomon Islands. Early this century there was evidence of distinct racial types or groups of mixed origin. The people were divided into twelve distinct, originally totemic, matrilineal clans, most of which spoke different dialects, some of which were still in evidence when attempts were made to obtain vernacular plant names in the early 1980s. However, most dialects have become obsolete, having been replaced by the principal dialect, which was used for Bible translation by European missionaries early this century (Viviani 1970).

The traditional subsistence economy of Nauru was based on coconut and pandanus as the main staples, a limited range of wild terrestrial food products, sea birds, such as the brown and black noddy terns (*Anous* spp.) and a very wide range of fish and other marine foods. Milkfish or *ibiya* (*Chanos*) fry, collected from the reef at low tide, were farmed in family-owned divisions of Buada Lagoon to provide fish for special occasions and when other supplies failed. Their housing, tools, clothing, medicines, fuel, fishing equipment, canoes, dyes, ornamentation, perfumes, toys and other material and many of their non-material needs were satisfied from their environment, especially from plants. For details on the use of terrestrial and marine resources see sections 2.7 to 2.9 above.

The Nauruan population suffered from introduced diseases against which they had no natural resistance, and from incessant tribal warfare, with Nauruans numbering only 1250 in 1910, a decline of 150 from the total of 1400 in 1840 and 300 less than recorded in the German census in 1905 (Viviani 1970).

The estimated population of Nauru in the most recent census in 1983 was 8042, of whom 4964 were Nauruan, with the balance comprised mainly of I-Kiribati (people of Kiribati, formerly the Gilbert Islands of the British Gilbert and Ellice Islands Colony), Tuvaluan, Chinese, Filipino or Solomon Island contract workers in the phosphate industry. There are also European, Indian and Pacific island expatriates working mainly for the Nauruan Government. The Nauruans live on the coastal strip and around Buada Lagoon, the phosphate workers in the Nauru Phosphate Company dormitory accommodation at Location near the phosphate loading cantilevers, and the expatriate civil servants in residential areas on the escarpment. The town centre is located between the airport and Location near the cantilevers, with most government offices near the airport.

2.4.2 Land Tenure

Land tenure is perhaps the most critical consideration in terms of the practicality of implementing programs for both the proposed post-mining rehabilitation and the implementation of resource conservation initiatives on Nauru. The following summary of the Nauruan land tenure system is based mainly on Viviani (1970) and work done by New Zealand anthropologist, Nancy Pollock, as part of the 1994 NACRDFS study.

For Nauruan society, land represents wealth in both spiritual and material sense, and has always been a mark of status. In earlier times the two chiefly classes, the *temonibe* and *engame* (the former descending from eldest sisters and the latter from younger sisters) were the chief decision makers and land-holders, as distinct from the *itsio* who were those who had lost land in battle, or those who were recent arrivals on Nauru and thus had no land. **Itsio** could only survive by working for the **engame**, receiving food and a tree or a small piece of land perhaps in return for their services. Land, thus, contributes strongly to a person's identity as a Nauruan. The concept of *angam* refers to the strong emotional tie between Nauruans and their home island.

Although rights to land are held by individuals, based on rights established by their ancestors, a strong concept of "family lands" persists, with most land still being regarded as belonging to the extended family.

Inherited rights traditionally covered both "coconut land" and "pandanus land". Coconut land was, in most cases, synonymous with residential land, where houses were built among coconut palms. The coconut palm was also the source of copra, the first important source of cash income. Pandanus land was usually found on Topside or occasionally on the more gradually sloping areas of the escarpment. Here pandanus trees were planted to yield the important fruit, which is eaten ripe as a snack food or processed into the staple *edongo* paste which can be stored as an emergency food. Pandanus land was also used for hunting

noddy birds, for crossing the island, and for general recreational activities, as well a being a main source of timber, firewood, medicines and a wide range of other plant products.

The vast majority of pandanus land later became the phosphate land of Topside and was divided into named portions on which markers were placed by the landowning family. Coconut land was also divided into recognized portions. Prior to mining, the boundaries of these named portions of phosphate and other lands were formalised by modern cadastral survey, the coordinates of which are recorded in the Nauru Lands Committee records, along with the names of all shareholders in each piece of land.

All subsequent inheritance of land from a deceased estate is now gazetted and recorded by this Committee. In this way, a modern system of land tenure identification and recording was introduced to Nauru to replace the traditional system of recognition that had existed prior to European contact. This system has gained greater economic importance over time, as royalties paid for extracted phosphate have become more significant. The economic imperative may have also been a factor in changing from the traditional matrilineal inheritance to the eldest daughter, to a greater sharing of land ownership, where each heir receives a more equal portion of the family land. The result of this trend has been fragmentation of ownership, a problem discussed in section 4.3.3 below.

There are according to the NACRDFS study 630 individual named pieces of land to which people in Nauru have tenure. Nauruans hold rights to these lands as individuals, inheriting some rights from their mother and others from their father or other relatives. Adopted children can inherit rights to land from both their adopted parents and their natural parents, although the latter were likely to be close relatives of the former. Rights were usually passed on just before the parent's death. Such rights allowed the individual a choice of lands on which to reside, collect coconuts for copra in German times, or hunt for noddy birds or other natural products. A person might also separately inherit rights to trees such as pandanus, coconut and tomano or **iyo** (*Calophyllum inophyllum)*, as distinct from the rights to the land on which they grew.

Even though these were individual rights, they were, and are still, governed by family protocol, and cannot be alienated without the consent of the rest of the family who may hold rights to adjoining lands. The importance of families owning adjacent lands was that it gave large extended families group security. Having strangers holding nearby land was not considered desirable.

In the past, the eldest daughter generally inherited the majority of the land, but was obliged to look after her siblings, her mother and the extended family. Today, however, rights to land are usually divided equally among siblings. Because these "individual" rights are land shareholding rights rather than individual rights to whole pieces of land, a situation now exists where single pieces of land have large numbers of legal shareholders. For example, because Nauruans have chosen to maintain the integrity of the 630 named pieces of land, and have chosen to designate rights by shares to each piece of land according to the amount passed on, an individual may hold l/12 share in a land such as Animaer, and 3/1160 in another piece of land, and so on. Such holdings may amount to a lot of land or very little. The system seems to have arisen because it ensured a share in phosphate royalties from a

given piece of land, and has only limited relevance for traditional uses of land. As stressed in a number of sections below, the system has frequently complicated government and other efforts to access or develop such lands, and will probably constitute one of the main obstacles to both the rehabilitation of the mined areas and the implementation of a system of protected areas on Nauru.

2.4.3 The Districts

In addition to individual land parcels, Nauru was traditionally divided into twelve Districts, eleven around the coastal Bottomside and extending on to Topside, and one Topside District, Buada, around the lagoon of the same name. Nauruans are registered into a particular District at birth, the name of which is given by either the child's mother or father. All siblings of the same parent do not necessarily share the same District registration. A Nauruan may decide to change District affiliation, with there being no residency implication. Rather, a person does have particular social responsibilities to other members of that District, to participate in sports competitions, and attend feasts there, contributing an appropriate amount of food and/or money, or attend meetings as required.

The District has developed into a political unit from which Councilors for the Nauru Local Government Council were elected beginning in l951, until it went into recess in l992. More recently, Districts elect Councilors to the Nauru Island Council, as well as electing Members of Parliament. The District is thus the basis of the democratic electorate. A District registration and affiliation can be changed by the mutual consent of the Chief Councillor of the District from which a person wishes to withdraw, and the Chief Councillor of the District to which that person wishes to join. Once approved, such a change of District affiliation is then gazetted.

Thus, the District as a social and political unit is of vital importance for consultation and consensus building, and is the accepted avenue through which Nauruans express their views.

2.4.4 Development History

After the first recorded European sightings of Nauru by John Fearn of the British Ship *Hunter* in 1798, who named it "Pleasant Island", there was little regular contact with the island until the 1830s when British and American whalers made regular stops for water and food, and beachcombers arrived. The beachcombers, with the introduction of new weaponry, intensified a period of almost incessant clan warfare. At the time of the beginning of formal colonial influence in the late 1880s the island "had the appearance of a battlefield" (Viviani 1970:22).

Nauru was brought into the German sphere of influence as a result of the Anglo-German partition of the Pacific Islands in 1886, and was formally annexed by the German Empire and incorporated into Germany's Marshall Islands Protectorate in 1888. Shortly after this event, phosphate deposits were discovered and mining began in 1906. Nauru remained a

German colony until Germany's defeat in World War I. In 1919 Nauru was designated a League of Nations mandate of Great Britain, Australia and New Zealand, administered by Australia.

During World War II, Nauru was occupied by Japan, and two-thirds of the population were deported to Chuuk (Truk) for the duration, where nearly one half of these died from disease and malnutrition. The current population of Nauruans has grown from a low base of about 1500 at that time. After World War II, the previous Mandate became a Trustee, again under the administration of Australia. Phosphate mining had continued for all this time, briefly interrupted by War, but was now conducted using large machinery.

In 1968, Nauru finally won Independence from the Trustee status, and became the Republic of Nauru under the Inaugural Presidency of Hammer de Roburt. Since that time Nauru has been governed by a Westminster style democracy with an elected Parliament and a President who is elected by that Parliament.

Apart from the provisioning of whaling vessels, mainly with fish, pigs and coconuts, the first regular non-traditional economic activity was a sporadic copra trade established in the 1880s. By the late 1880s Nauru produced about one million pounds (454,545 kg or 450 British tons) of copra annually, one of the main reasons that Germany, on the recommendation of resident German traders, annexed the island in 1888. In the 1890s, due to drought and infrequency of ships, the copra trade failed to reach its potential with Nauruans refusing to make more copra than needed to pay their taxes (Viviani 1970; Carter 1984).

The strategic and economic importance of Nauru increased dramatically with the discovery, in 1900, of high grade phosphate rock, containing up to 78 per cent tricalcic phosphate. The mining of phosphate, without approval of the indigenous inhabitants, began in 1906. Caroline Islanders and Chinese contract-laborers were recruited to mine the deposits. Since then, I-Kiribati, Tuvaluan, Filipino and Solomon Islands contract workers have been recruited to work in the phosphate industry. The deposits have been mined continuously since 1907, except for disruptions during World War I and again during World War II. Copra production continued to fluctuate, with over 300 tons having been exported the year before the phosphate trade began in 1906, 277 tons in 1916, and falling to only 10 tons in 1918 due to a prolonged drought (Viviani, 1970: 22-38).

With the beginning of the phosphate trade, the whole pattern of Nauruan life began to change. Although barter continued, money became the medium of exchange, and trade stores with their array of goods, further encouraged the trend. As Viviani (1970:38) argues:

> Old crafts such as mat making began to be forgotten as woven materials become available. Rites and customs were debased. Faced on all sides by the white man's attempt to dominate their environment and the disintegration of their culture, the Nauruans sought a new orientation for their lives. They could no longer follow the old ways completely and so settled for a combination of the basic elements of the old culture, clinging

> strongly to their family life, and some of the advantages of Western civilisation. They were able to achieve this because, although royalties were low - only about 230 Pounds Sterling (about A$500) per annum at this time for the whole population - this money, together with land rents and some return from copra, freed them from the necessity of working on the phosphate fields to pay their taxes.

The most disruptive period for Nauru was World War II, during which the island was almost continuously bombed by Japanese and Americans planes. Beginning in 1940, five phosphate vessels were sunk off Nauru and the island shelled by German warships. Nauru was again bombed by Japanese planes in 1941 and 1942 prior to Japanese occupation of the island. After a Japanese military airstrip was completed in 1943, the island was bombed almost continuously by Allied planes. By the end of 1943, due to the importation of at least 3000 Japanese marines, some 1500 Japanese and Korean laborers, and the relocation of 700 Banabans to Nauru, the food situation became so serious that 1201 Nauruans, seven Chinese and two priests were deported to Truk. Malnutrition and dysentery were widespread. Allied bombings increased considerably until the Japanese surrender to an Australian occupation force in 1945. At this time, of nearly 5200 people, only 591 were Nauruan, and the destruction of the phosphate works and buildings on Nauru was almost total. The 737 Nauruans who had not died under the harsh conditions imposed by the Japanese in Truk returned home in 1946 (Viviani 1970; Carter 1984). As argued by Viviani (1970:85):

> The Japanese had destroyed the Nauruan's homes, schools, and churches, placed them on a semi-starvation level and destroyed much of what was left of their old way of life. The deportation of two-thirds of the Nauruans and the death of nearly 500, mostly the old and the young, left the society after the war with a gap in generations and a disruption of family life. Again the Nauruan population had fallen well below the 1,500 level which the Nauruans themselves regarded as a minimum for survival.

2.4.5 Contemporary Economy

Nauru's main export continues to be phosphate, with the sporadic export of copra having ceased in the 1950s. Phosphate earnings have made Nauru among the wealthiest nations in the world in terms of per capita income, although the distribution of wealth is uneven due to unequal land rights to phosphate deposits. Nauru is considered totally urbanized, with Nauruans having almost completely abandoned subsistence production, except for the harvest of coconuts and pandanus fruit for consumption and of pandanus leaves for plaited ware; the acquisition of fish and other seafood, and the hunting of noddy terns, which are considered a delicacy of chiefly status. the capture and caring for of frigate birds as

pets is also a traditional pastimes. Most of the limited subsistence agricultural production is in the hands of immigrant communities.

The sea provides virtually all the locally-produced animal protein in the diet, with local terrestrial resources (pigs and chickens and sea birds) comprising an insignificant part of the diet. Tuna fishing licensing fees and possible exploitation of these resources locally for export to Japan or Hawaii are also possibilities could make an important contribution to the national economy and small-scale subsistence and commercial fisheries will continue to be an important source of cash income and have important nutritional and social roles to play in sustainable development.

In 1970 Nauru establishment of its own heavily subsidized international airline, Air Nauru, which flies to Asia, Australia, New Zealand and other Pacific islands. This has accelerated the processes of urbanization and an increasing dependence on imported products. Of concern is the impact that the destruction of the traditional subsistence food system, rapid urbanisation and the almost total dependence on nutritionally-poor imported food and drink, including extremely high rates of alcohol consumption, have had on the health of Nauruans, which have the very high rates of obesity, dental disease, alcoholism and nutrition-related non-communicable diseases such as diabetes, cardiovascular disease, gout and hyperuricemia and liver cancer. All are causes of premature mortality.

The Nauru Fishing Corporation was established in 1976 and formerly controlled a freezing plant, a katsuobushi (smoke-cured tuna) plant, and two purse seiners purchased from South America in 1980. Although still enacted by law, the NFC no longer operates.

An increasing amount of revenue is received for licensing fees paid to the government by distant fishing nations fishing within Nauru's EEZ, and there have been limited exports of fresh tuna for the Japanese sashimi market on Air Nauru when it flew into Japan in the past.

In terms of Nauru's economic future, the phosphate deposits on Nauru are projected to be depleted shortly after the turn of the century. Fortunately, a significant proportion of recent phosphate returns have been invested in overseas properties, businesses and investment funds to provide income in post-phosphate-mining Nauru. A minor source of income has been derived from Nauru's status as a "financial center" or "tax haven" for overseas companies wishing to register there.

In 1994, subsequent to a Deed of Settlement with Australia, Nauru has received a settlement payment of approximately $A165 million which has been designated for rehabilitation of the mined-out areas of Nauru. Although an initial amount of A$115 million has been already given to the Nauru government for this purpose, the balance will be paid at $A2.5 million per year over the next 20 years to implement a plan developed as a result of the Nauru-Australia Cooperation Rehabilitation and Development Feasibility Study (NACRDFS). The resultant blueprint for rehabilitation includes residual mining, pinnacle removal and crushing, the economical use of pinnacle rock and aggregate, reforestation, agricultural development, environmental protection, housing, and human resource development.

In September, 1994, the Project team submitted their final Report in seven volumes. These volumes have provided a great deal of information about Nauru's physical and biological environment, and have proposed a detailed series of recommendations to carry out the rehabilitation of post-mining Nauru. Implementation of the plan will depend upon many factors. Most importantly, is whether an agreement can be framed by Nauruan with respect to both the priorities for development and what types of land tenure arrangements and appropriate compensation to landowners can be arranged to allow the rehabilitation to proceed.

Given Nauru's continued official support for regional and international environmental initiatives and the recent completion of the NACRDFS plan, the preparation of this National Environmental Management Strategy (NEMS) is particularly timely.

CHAPTER 3

ENVIRONMENTAL INSTITUTIONS AND LEGISLATION

The strengthening of the environmental capacity and the ability to address the main constraints to environmentally sustainable development in Nauru depend to a great extent on the nature of environmental institutions and legislation in the country. This chapter discusses those institutions currently responsible for environment-related activities in Nauru and existing legislation that relates to environmental issues.

3.1 ENVIRONMENTAL INSTITUTIONS

There are a range of government and non-government institutions or organisations which have responsibilities for environment-related matters and for the enforcement of existing legislation.

3.1.1 Government Ministries

The Ministry of Island Development and Industry (IDI) is the lead agency in the planning and administration of environmental matters in Nauru. It is the ministry responsible for energy, agriculture, marine resources, fisheries, tourism, culture, and the national airline, Air Nauru. In fact, IDI is responsible for the general planning and development of all new (non-phosphate-related) industry in Nauru and is the ministry responsible for the implementation of the rehabilitation of the island under the Nauru-Australia Cooperative Rehabilitation and Development Feasibility Study (NACRDFS). The President of Nauru is the Minister for IDI, as this is generally seen as the most important ministry in terms of Nauru's future development. This NEMS, commissioned by IDI and funded by SPREP, is seen as central to the strengthening of environmental capabilities both within IDI and in Nauru generally.

To strengthen its environmental capabilities, IDI has recently appointed a SPREP-funded Environment Officer. The position has the responsibility of coordinating environmental management activities in Nauru by both the public and private sectors, and of acting as a contact person for international environmental activities and programs (particularly SPREP programs).

IDI also supplies a number of media services to the people of Nauru, and thus has a major role to play in non-formal environmental education. For example, Nauru has a very modern system of communications, including national radio and television stations, a weekly news bulletin and fixed and mobile telephone systems. These media are extremely well placed to contribute to environmental awareness campaigns, and may even play a sponsorship role.

The Nauru Fishing Corporation (NFC) was established under IDI in 1976 and formerly controlled a freezing plant, a katsuobushi plant, and two purse seiners purchased from South America in 1980. Although technically still existing on paper, NFC has not active programs, and the purse seiners now fish on contract to overseas fishing interests.

Air Nauru, as the national airline, provides the main air link between Nauru and other countries, providing transport, freight and mail-carrying services. The environmental effects of the airline are concentrated in the vicinity of the airport in Yaren and Boe Districts, where land has been leased from the owners, although the unrestricted introduction of plants and planting materials, currently mainly consisting of ornamental plants could constitute a threat to future agricultural development in Nauru. Of possibly greater concern is the real possibility of the introduction, via Air Nauru, of the brown tree snake from Guam, where it has become an extremely serious and uncontrollable pest. In Guam is has virtually wiped out the indigenous bird populations, constitutes a danger to the human population, causes frequent power failures when it gets into electrical wiring systems, and has negative impacts on Guam's growing tourism industry.

Although it does not have a specific role in environmental matters through legislation, the Ministry of Education has a central role in the promotion of environmental education through the school system. Awareness of environmental issues has been identified by this study as being of highest priority, and education and training programs will be needed at all levels. There is also an opportunity for this Ministry to become involved in servicing the environmental training needs of other Ministries and in providing environmental education material to the media.

The Ministry of Works and Community Services (MWCS), although not administering specific environmental legislation, is intimately involved with the management of Nauru's urban environment. It has responsibility for the provision and maintenance of public housing and government buildings, and is responsible for waste disposal from the latter. It also has the responsibility for the maintenance of roads and drainage and the provision of services within buildings.

The administration and enforcement of existing environmental legislation (see below) in Nauru lies mainly with the Ministry of Justice, with a secondary responsibility for environmental health lying with the Ministry of Health and Medical Services (MHMS).

3.1.2 The Nauru Phosphate Corporation (NPC)

The Nauru Phosphate Commission (NPC), which is constituted by an Act of Parliament, has the major responsibility for the mining, processing and sale of phosphate. It is also responsible for the operation of the harbour, fuel storage and distribution, some waste disposal, and the provision of many of Nauru's services. It also plays a significant role in the planning and implementation of infrastructural development. As a result of its wide responsibilities, NPC has a critical role to play in environmental projection and management. Its service provision capability is independent of any Government Ministry.

The supply of electricity (240v domestic service and street lighting) via overhead powerlines is provided on Bottomside by the NPC, which also operates and maintains the power station. Around Buada Lagoon, powerlines have been run underground at the request of the residents, reportedly because of concern over the possible detrimental effects of powerlines on mango trees. Although the initial cost of installation of underground powerlines is higher than overhead lines, subsequent maintenance costs are reduced, and the safety and visual benefits are

obvious. Transformers can be mounted on concrete slabs on the ground where needed, and more decorative poles used where public lighting is required.

A modern desalination plant has recently been commissioned by NPC, using the waste heat generated from the power station. This is the island's current supply of water which is delivered in tank-trucks to individual household and other storage tanks via road transport. Storage facilities for potable water are restricted to household and institutional storage tanks, because the extreme porosity of the soil and bedrock rules out the easy construction of dams or reservoirs.

NPC also has a special projects capability that can be used for industrial and other developments that may or may not be ancillary to it's primary phosphate mining, processing, storage and shipping functions. For example, NPC has established a roadside replanting and beautification program and a small nursery to support it, and has constructed an artificial waterfall behind the golf course as part of the 25th anniversary celebrations of the establishment of NPC, at a cost of about $A1,000,000.

3.1.3 The Role of Nauru Island Council (NIC)

The Nauru Island Act of 1992 specifies the "purposes and detailed objectives" of the Nauru Island Council (NIC) and its activities at the District and community levels. These include the provision of services such as waste disposal, promotion of cultural activities, landscaping and improvement of the urban environment, and coordination with other public bodies to ensure the efficient provision of services and facilities and the effective use of resources. In particular, Schedule 1 of the Act refers to environmental control, protection and conservation of flora and fauna, bio-aesthetic planning of the island and related activities.

The NIC has an Environmental Officer who is qualified in landscape design. The 1993 Annual Report outlines some of the environmental programs currently underway, including the documentation of native plants of Nauru, the establishment of a production nursery at the Topside dump site for supply of native and exotic plants to both NIC projects and to the public, and an ongoing public environmental education program. A survey of some pests of vegetable and fruit varieties has also been undertaken. It is clear that NIC has an important role to play in environmental management and education at the District level, and should be involved in the consultative process.

3.1.4 Non-Government Organisations (NGOs)

Local non-government organisations (NGOs) having an interest or playing a role in environmental issues include the Nauru Environment Association (NEA), the Nauru Fishermen's Association (NFA), the Nauru Divers' Association (NDA), the Women's Information and News Agency (WINA), the Nauru Women's Circle (NWC), and the Nauru Women's Association (NWA).

Members of NEA, Nauru's only strictly environmental NGO, have been involved for a number of years, as volunteer workers, in "hands on" projects, such as planting coconut palms, food trees and other trees around the island and helping to reduce litter.

The NFA and NDA have a specific interest in one aspect of Nauru's environment - the fringing reef and (inshore) fishery, have a wealth of anecdotal information regarding this resource, and have an important role in promoting its sustainable utilisation.

Members of the various Women's groups have also taken part in the above activities, and are becoming increasingly well organised and informed, due to their networking program with Women's groups in other countries. WINA, in particular, has actively highlighted environmental issues in their newsletter.

All the above-mentioned NGO's are very interested in environmental issues, and should be involved in aspects of the consultative planning process.

3.1.5 The Proposed Nauru Environmental Coordinating Committee

Many of the Government agencies and NGO's referred to above are undertaking worthwhile activities in environmental management, but almost always in isolation from one another. There is an enormous potential to gain strength and synergy from joining together to coordinate their individual efforts in a spirit of informed co-operation. It is for this purpose that a Nauru Environmental Coordinating Committee (NECC) has been proposed to bring together the stakeholders with an interest or role to play in environmental management in Nauru. The members of the NECC would all be representatives of the Government bodies and NGO's referred to above, with the Chair elected on a rotating basis, for a term of one calendar year. The proposed NECC is discussed below in Chapter 5.

3.2 ENVIRONMENTAL LEGISLATION

At the present time, legislation related to environmental issues is found in at least seven different Ordinances and Acts. There are also at least twelve international treaties, agreements and conventions that relate to environmental issues to which the Republic of Nauru is signatory.

3.2.1 Ordinances and Acts

Laws in the Republic of Nauru that pre-date independence (i.e. before 1968) were termed "Ordinances". These generally remain in force unless and until they are repealed. Since independence, legislation has been enacted as "Acts of Parliament. In the case of many of these Acts, the relevant Minister, or Cabinet itself, has the power to issue "Regulations" to define what can or cannot be done under a given Act.

One of the earliest Ordinances that addresses (cultural) environmental issues was the Nauruan Antiquities Ordinance (1935), designed to control the preservation and export of:

> Nauru relics and curios and articles of ethnological and anthropological interest or value, and articles manufactured . . . according to Nauru methods, and historical remains of any description, and such other articles or things of historical or scientific value or interest and relating to Nauru as may be prescribed.

This Ordinance requires the immediate reporting of:

> caves or other places in which ancient remains, human or otherwise, are to be found; representations on rocks or in caves of living beings or inanimate objects; deposits of historical remains of any description; or places used in former times as ceremonial or initiation grounds".

The current relevance of this Ordinance may be open to question, given the extensive effects of phosphate mining that have disturbed topside over the past ninety years. The enforcement agency for this Ordinance is the Customs and Immigration Department of the Ministry of Justice.

Another early piece of legislation is the Wild Birds Preservation Ordinance of 1937. This prohibits the taking of frigate birds without permission, effectively provides a year-round closed season for "magpies, snipe, quail, white noddies, and etsirer (Nauru canary)", and a closed season from the 1st of August to the 31st October for the black noddies. Enforcement is presumably by the Police, under the Ministry of Justice.

The issue of environmental health is covered by the Public Health Ordinance (1925-1967, as amended). This ordinance addresses the issues of the prevention of disease and maintenance of health, sanitation, control and inspection of food shops, eating houses, barber shops, the slaughtering of animals, and the preparation, sale and distribution of food. The Ministry of Health and Medical Services employs Health Inspectors to enforce the Act.

The Lands Act of 1976 makes provision for "the leasing of land for the purposes of the phosphate industry and other public purposes, and for the removal of trees, crops, soil and sand and the payment of compensation and other moneys". The conditions of lease to the Nauru Phosphate Corporation allow explicitly for the "removal of topsoil, trees and vegetation from that land and to use, destroy or otherwise dispose of them". However, Section 8 paragraph 3 states that "The Corporation shall be liable to rehabilitate any land from which phosphate is mined . . . if required by the cabinet by notice in writing to rehabilitate such land".

Compensation is also prescribed when trees and vegetation are removed, according to a schedule that places a value, between lower and upper limits depending on age and condition at the time of removal, on the following trees: coconut, pandanus, breadfruit, mango, papaya (pawpaw), almond (*Terminalia catappa*), tomano (*Calophyllum inophyllum*) and lime. For

example, a tomano tree is valued at between $2.50 and $50, and a pandanus tree between $5 and $60.

The Marine Resources Act of 1978 is designed to regulate the fishing industry, both inshore and within the 200-Mile Exclusive Economic Zone (EEZ). Under the Act, Cabinet makes Regulations, and the Minister has authority to grant licenses and exemptions, and specify the total allowable catch (TAC) for different species.

In 1992, a review of Regulations under the Act by Michael Lodge recommended prohibition of fishing methods such as spearfishing and drift net fishing, the use of certain equipment such as SCUBA, and the taking of marine mammals. This review also recommended minimum sizes for rock lobster (and no eggs) and octopus, minimum length for turban shell, blue-tail mullet, topsail drummer and rainbow runner, and minimum size (and no eggs) for the coconut crab. Turtles were recommended for protection through the banning of egg collection of all turtles and the taking of hawksbill turtle shell. These recommendations are currently being considered by Cabinet.

The licensing of dogs, destruction of dangerous or diseased dogs, and destruction of dogs in the event of rabies is covered by the Animals Act of 1982. Cabinet may prohibit the importation of animals of any species. At the present time, female dogs or entire male dogs are prohibited imports, as are bees of any species or sub-species. These prohibitions are regarded as important both for quarantine reasons and for the protection of indigenous wildlife. Enforcement is by the Customs and Immigration and the Police Departments.

The Litter Prohibition Act of 1983 allows for fines of up to $300 for the offence of littering. Enforcement is by the Police Department. This Act is comprehensive in its description of littering, but enforcement appears to be non-existent.

To summarise, the existing Ordinances and Acts that have relevance for addressing environmental issues are concerned with the conservation of Nauruan antiquities, wild bird preservation, public health and sanitation, clearing of leased land and its rehabilitation, marine resource management, import restrictions on certain animal species, and littering. Enforcement in general is by the Police and Customs and Immigration services of the Ministry of Justice, and by the Ministry of Health. The extent of prosecutions under the various Acts has not been reviewed for this study, but seems to be minimal.

3.2.2 International Conventions and Treaties

Nauru is a signatory to a number of international conventions and treaties related to environmental issues of international concern. These include:

1. The International Plant Protection Convention (1951). This Convention covers cooperation required between nations to control the spread of plant pests and diseases.

2. Treaty on the Non-Proliferation of Nuclear Weapons (NPT)(1970).

3. Convention on the Prevention of Marine Pollution by dumping of Wastes and other Matter (London Dumping Convention)(1972).

4. South Pacific Forum Fisheries Agency Convention (1979).

5. United Nations Convention on the Law of the Sea (UNCLOS)(1982)

6. Convention for the Protection of the Ozone Layer, Vienna (1985).

7. South Pacific Nuclear Free Zone Treaty, Rarotonga (1985).

8. Protocol for the Prevention of Pollution of the South Pacific Region by Dumping (1986)

9. Convention for the Prevention of Fishing with Long Driftnets in the South Pacific, Wellington (1989).

10. Convention on Climate Change, Rio de Janeiro (1992).

11. Convention on Conservation of Biodiversity, Rio de Janeiro (1992).

12. South Pacific Regional Environment Programme (SPREP) Convention, Noumea (1993?).

11. Convention on the Prohibition of Chemical Weapons (date?).

14. Convention to Ban the Importation into Forum Island Countries of Hazardous and Radioactive Wastes and to control the Transboundary Movement and Management of Hazardous Wastes within the South Pacific Region, Waigani, Port Moresby (1995).

The active position Nauru has adopted with respect to these issues signifies the Nauruan Government's philosophy towards, and interest in, the protection of the global and Pacific environments for the benefit of future generations.

This interest is also reflected in the commitment to the recommendations of the recent Nauru-Australia Cooperative Rehabilitation and Development Feasibility Study NACRDFS undertaken with respect to the mined-out phosphate lands. The NACRDFS, which contains, in its eight volumes, detailed recommendation, programs and activities, for the rehabilitation and protection of the island, constitutes an integrated plan for environmental management of the Nation as a whole. The principles contained in these agreements can be translated into Government policies and legislation. The suggested activities under the NACRDFS will serve as a basis of Nauru's Environmental Action Plan, especially with respect to the rehabilitation and development of the mined areas. As stressed above, IDI currently has the responsibility for the implementation of rehabilitation of Nauru under NACRDFS.

CHAPTER 4

ENVIRONMENTAL ISSUES AND CHALLENGES

There is a range of major issues and challenges to environmentally sustainable development that need to be addressed by a National Environmental Management Strategy (NEMS) and the associated Nauru Environmental Action Plan (NEAP).The issue in this NEMS are those that are of concern to Nauruans according to a survey of informants during February 1995. They refer to the current state of the Nauru environment, the nature of international development initiatives, the state of the world economy, the current lifestyles and levels of environmental awareness in Nauru, and the existing national environmental infrastructure.

Many of the same concerns were raised by different groups, at different times, in different ways. These are prioritised to some extent, according to the number of times they were raised, grouped together in the NEMS under thirteen main headings, and include:

1. Land degradation.
2. Inadequate environmental education, public awareness and training.
3. Inadequate environmental infrastructure and legislation.
4. Loss of biodiversity.
5. Coral reef and marine degradation and overexploitation.
6. Pest and disease infestations.
7. Pollution and waste management.
8. Population growth and urbanisation.
9. Health and nutritional deterioration.
10. Economic vulnerability and instability.
11. Inadequate development infrastructure.
12. Global climate change.
13. Radioactivity and nuclear pollution.
14. International traffic in toxic and hazardous waste.

4.1 LAND DEGRADATION

The degradation of land is the environmental issue of greatest concern to the people of Nauru, being mentioned by all groups that were consulted for their opinions. This includes the almost total degradation of topside, and localised inland and coastal erosion, which is a problem of increasing concern. Programs to address the rehabilitation and protection of land are discussed under Objective 1 in the National Environmental Action Plan in Chapter 5.

4.1.1 Degradation Due to Phosphate Mining

The most drastic land degradation has been caused by the removal of natural vegetation, top soil, phosphate rock and the almost total modification of the landscape of topside as a result of phosphate mining. This is by far the most widespread and visible environmental concern in the country - an impact that has had a direct or indirect influence on all other environmental impacts and cultural change over the past ninety or so years.

By the time primary mining is completed early next century, approximately 1400 ha of Topside, including portions of the escarpment will have been affected. This represents nearly two thirds of the entire country, which will have been converted from a gently undulating, productive forest land to an almost totally unproductive pinnacle and pit topography, often referred to as the Nauru "moonscape". Even though there are varying degrees of vegetative re-growth, depending on the time since mining, the composition of this re-growth is extremely limited and stunted, contains many introduced plant species and, without extensive rehabilitation, remains functionally useless.

Detailed plans to rehabilitate the mined-out lands have been developed by the NACRDFS. These are summarised in Program 1.1 of the NEAP, with proposals for a Rehabilitation Trial suggested in Program 1.2.

4.1.2 Erosion and Loss of Soil

Localised soil erosion, coastal erosion and the loss of limited soil resources are also important concerns. The soils of Nauru have been studied in detail and reported on in the Forestry component of the NACRDFS. This report shows that throughout the history of phosphate mining, much topsoil has been lost from the island, although a proportion remains in the form of stockpiles and underneath roadways. However, these stockpiles are estimated to provide only enough soil to reinstate approximately 440 hectares of land (or 32%) after rehabilitation, out of 1400 hectares that have been mined. Thus, the existing soil resource of Nauru is particularly precious and any incidence of erosion is of especially great concern.

The soils of Nauru that do remain in undisturbed sites are generally of quite high fertility, although their agricultural potential is limited by a low moisture-holding capacity, and possible nutrient availability problems due to high alkalinity. Soils in Nauru are like those of all small island in the Pacific - a very precious resource - whose conservation is of the utmost importance.

Both coastal and inland erosion are increasing problems in Nauru. Coastal erosion is occurring due to the restriction of along-shore processes by development of reef channels and the extension of the airport runway, and the disposal of concentrated stormwater runoff. Development of buildings very close to the upper tide limit may also be affecting the coast, and these buildings are likely to be damaged by storm surges that correspond to a higher than usual tide (for example, the "King Tides" of June 1994).

Because the soil surface is so porous in Nauru, run-off from natural surfaces is uncommon. However, in urban areas where surfaces are compacted or sealed, the frequent storms often cause local flooding from concentration of stormwater run-off, particularly from road and roof surfaces.

When the ring road was constructed around Nauru, both high and low points were designed to allow drainage from the road surface to flow efficiently to a number of discharge points. Over time however, these points have become blocked with sediment and litter, causing ponding to occur, which is a severe traffic hazard. Again, because of the difficulty in obtaining permission to carry out works on private land, the problems tend to be "put up with" rather than solved.

The erosion of the coastline is regarded as of special concern due to the possibility of global warming-induced sea-level rise. An Environmental Case Study entitled "Overexploiting Coral Reefs: Reef Blasting in Nauru" was recently published by SPREP (1993), outlining the damage to the reef due to the enlarging of the boat channel at Anibare Bay. In addition, further work is being planned for this, plus additional boat channels following the report by Shuma (1994), to facilitate access for the newly acquired amphibious vehicle 'Bagewa'.

Thus, in view of these and other proposed works, and the degree of concern over soil and coastal degradation, it is recommended that a survey be undertaken to document the current extent of the problem, and develop policies that will minimize current and future possible damage to Nauru's soils and coastline and implement programs to conserve or manufacture soil (see Programs 1.3 and 1.4 in Chapter 5).

4.2 INADEQUATE ENVIRONMENTAL EDUCATION, PUBLIC AWARENESS AND TRAINING

Inadequate knowledge about the environment and about local and international environmental issues is something that affects every Nauruan and is considered by most people consulted to be the major constraint to the promotion of environmentally sustainable development in Nauru. "Environmental blindness" or lack of environmental awareness is shown in four ways. These include:

1. The loss of traditional environmental knowledge and awareness of, and respect for, the natural environment and plants and animals as a life support system.

2. Inadequate public awareness of international and local environmental problems and constraints to environmentally sustainable development.

3. Inadequate environmental and science education in the formal education system at all levels.

4. Shortage or absence of upper and middle-level personnel with formal training in environmental science and related subjects.

Programs to address these problems, including the establishment of a Master Environmental Education Plan, and Environmental Education Sub-commitee and an Environmental Resource Centre, are discussed under Objective 2 in the National Environmental Action Plan (NEAP) in Chapter 5.

4.2.1 Loss of Traditional Environmental Knowledge and Awareness

Knowledge and understanding are the bases of caring for our environment. Before European contact, Nauruans lived a self-sufficient lifestlye which depended on their great knowledge and respect for their island environment and its terrestrial and marine resources. Their family lands and their island environment was the source of both material and spiritual wealth, something inherited from their gods and something to be passed on to their children and their children's children. The brightest people knew the uses, lore, legends, and language of the land and sea, information that was passed down by word of mouth, generation after generation.

However, changes to the Nauruan lifestyle and the environment that have taken place during the twentieth century, have been as dramatic as anywhere else on earth. Urbanisation and westernisation of Nauruans has led to widespread loss of traditional knowledge about the plants and animals and their environment, and to the destruction of the island environment that had served for centuries as their outdoor classroom and provider of most of their needs.

Few of today's young and middle-age Nauarans know the names of plants and animals or have in-depth knowlege of the natural history of their land and marine environment. This shows clearly in an increasing lack of respect for the environment and lack of concern for its protection from degradation by both Nauruans and outsiders. Unless this knowledge is preserved it will be very difficult to promote the sustainable use of the terrestrial and marine resources that still exist in Nauru. Program 2.2 of the NEAP is designed to promote traditional environmental knowledge and awareness.

4.2.2 Inadequate Public Environmental Awareness

Some Nauruans are not aware of international and local environmental problems, nor the constraints to sustainable development. There is a great need for programs promoting environmental awareness. Although Nauru has played a prominent role in international initiatives to address global environmental problems, the majority of Nauru's people remain poorly informed about problems such as climate change and sea level rise, the importance of biodiversity conservation, nuclear pollution, declining fish stocks and the dangers of unsafe waste disposal. These issues need to be brought to the attention of the general public. A "Keep

Nauru a Pleasant Island" Competition, an "Enviro-Media Campaign" and a pilot "Operation Clean-up Nauru" are discussed in Programs 2.3, 2.4 and 2.5 in the NEAP.

4.2.3 Inadequate Environmental and Science Education and Training

Inadequate environmental and science education in the formal education system at all levels is of serious concern in Nauru. There are no Nauruan science teachers, while most teachers, some without degrees, are recruited from overseas. Laboratory facilities are almost non-existent and little field or laboratory work is carried out.Very little relevant curriculum material is available.

This lack of emphasis on science education has resulted in a shortage of upper and middle-level personnel with formal training in environmental science and related subjects. Although there are Nauruan medical personnel, there are few if any other trained Nauruan scientists. Strengthening of science education and the awarding of scholarships for study towards environmental or science degrees are seen as being of utmost importance if the long-term implementation of a NEMS is to be effective. Programs 2.6 and 2.7 of the NEAP address the need to upgrade science education in Nauru and to provide tertiary training in science and environmental management.

4.3 INADEQUATE ENVIRONMENTAL INFRASTRUCTURE AND LEGISLATION

A major pre-condition for the successful implementation of the NEMS is the need to strengthen environmental infrastructure and legislation in Nauru, to provide a framework for the planning process of sustainable development.

4.3.1 Inadequate Environmental Infrastructure

At present there is limited formal integration of environmental considerations into the policy making and development planning processes and only limited environmental management capacity. Associated constraints include a lack of human resources, limited data on resources, particularly marine resources, and the highly degraded current state of the Nauru environment due to phosphate mining.

Although IDI has been given responsibility for environmental matters and Nauru has been very active in international environmental initiatives, there is no environmental department, no environmental coordinating committee, no environmental impact assessment procedure, and only recently has a SPREP-sponsored Environmental Officer been appointed. There are no staff trained specifically in environmental science, although there are number of staff members currently studying toward degrees in related fields overseas or through extension studies.

Because of the cross-sectoral nature of environmental management, there are many Government agencies and NGO's currently undertaking worthwhile, but often overlapping, activities in this areas, but almost always in isolation from one another. There is great potential

to strengthen environmental activites in Nauru by joining or coordinating these individual efforts in a spirit of informed co-operation. It is for this purpose that a Nauru Environmental Coordinating Committee (NECC) has been proposed: to bring together the stakeholders with an interest or role to play in environmental management in Nauru. The possible composition and responsibilities of an NECC are discussed as Program 3.1 in the NEAP presented in Chapter 5. The need to adopt an Environmental Impact Assessment (EIA) procedure and to establish a land-use planning system are important requirements for more informed development and environmental management. These are discussed in Programs 3.2 and 3.3 of the NEAP.

The lack of human resources in environmental planning, environmental law, conservation and EIA is a particularly serious problem. Until such time Nauruans receive specialist training in these areas, Nauru will find it difficult to coordinate and implement the NEMS and NEAP. There will be a contiuing dependence on overseas expertise to design and implement programs and activities of the NEMS. This concern is addressed in Program 2.7 in the NEAP.

4.3.3 Land Fragmentation and the Need for Land Tenure Reform

A major obstacle to long-term planning for environmentally sustainable development in Nauru is the nature of the land tenure system. In particular there is excessive fragmentation of ownership, and publicly owned land. This makes environmental management and conservation area development difficult makes the rehabilitation of Nauru extremely difficult. Logic dictates that the Government needs to have greater control over land use through a planning system similar to that in use in other similarly urbanised societies.

Wholesale or widespread resumption of land to Public or Government ownership is not likely to be a popular policy in Nauru, but to do so for the "common good" is a powerful argument for some resumption of land or long-term leasing arrangements, especially of those lands designated for facilities and uses designed for the long-term collective benefit of the Nauruan people (e.g., airports, sports facilities, reservoirs, conservation areas, etc.). Arrangements for appropriate financial compensation for affected landowners would have to be negotiated.

The current land tenure system may also have contributed to the prevailing attitude of the Nauruan people to their environment. For example, the ownership by an individual of one-twentieth or one-hundredth of a parcel of land only has practical meaning in the context of receiving an income from the mining royalty for that land. Such fractional ownership by an individual does not confer rights of exclusive use for, say, housing or agriculture, on that land, or for any other productive purpose. Once mining is completed on that land, the land is effectively locked up, unavailable for development or conservation. If one hundred or more people, all with different hopes and aspirations, own a parcel of land, how can they be expected to ever agree on it's fate?

Another aspect of this system is that an individual may own a share in several or many parcels of land, and be relatively affluent in terms of royalty income, but have nowhere to live! He or she may have nowhere to call "home", because the land ownership is shared with many

other individuals, who may also be in the same or similar situations. The system here is clearly not satisfying the basic need for shelter of these individuals, who effectively have become alienated from their own land.

Such a scenario causes firstly a loss of knowledge or intimacy with the land for the landowner, and changes his or her view of the worth of the land. Pride of ownership that comes from intimate contact and familiarity is lessened, and the land becomes something to be used and exploited for its (non-renewable) resources, to provide an income. The landowner's psychological attachment to the land is lost. He or she no longer walks over the land with their children. Awareness of the environmental values inherent in the land become lessened, to the point where respect is lost for the land, along with the traditional stewardship role of the owners. Ultimately, the land becomes an impersonal source of income, jealously guarded as "my land, my rights" for the associated income, but with no counter-balancing responsibilities. Further, there will be very little left for future generations, except an ever-decreasing share in whatever parcels of land that they are fortunate enough to inherit, and that are yet to be mined.

It could be argued that if the existing land tenure system continues, one unavoidable consequence will be a continuing dilution of individual shares. This will come about as a consequence of population increase and the inheritance system, where there will be an accompanying increase in the number of individual owners of each parcel of land. The logical end result of this at some stage in the distant future will be that virtually every parcel of land will be owned simultaneously by every Nauruan! This is clearly no different from Public (i.e. all the people) ownership of the land, the irony of which is surely not lost on thinking Nauruan landowners!

Program 3.4 of the NEAP deals with land reform, and possible ways in which land parcels can be amalgamated so that rehabilitation and land-use planning can be effectively implemented.

4.3.4 Inadequate Environmental Information

Although much is known about Nauru's plants and the mined-out lands, there are inadequate data on marine resources and development impacts on Nauru's environment upon which informed decision making and planning can be based. Associated with this is the need for the establishment of an environmental data base or Geographical Information System (GIS) into which such information can be put so that it is readily available to planners, environmental managers and other potential users. The need for further baseline studies and the development of an environmental data base or GIS system are addresses in Programs 3.5 and 3.6 of the NEAP in Chapter 5.It should be noted that a GIS was developed by the NACRDFS team, using MapInfo software, and this is still available in Nauru.

4.3.5 Inadequate, or Non-enforcement of Environmental Legislation

Inadequacy or non-enforcement of environmental legislation, and the need for the integration of existing legislation for environmental management and protection, are major constraints to the promotion of environmentally sustainable development in Nauru. In general,

most people consulted indicate that much existing environment-related legislation is not relevant to current conditions in Nauru.

For example, there seems to be some doubt about the relevance of some parts of the Wild Birds Preservation Ordinance, that allows for the protection of Australian magpies, when these were allegedly all shot by occupying Japanese forces during the Second World War. Uncertainty also exists about the actual dates of the closed season for black noddies, with most people unable to give the correct dates, when asked. The closed season for hunting is also said to be openly flouted by some groups. It is clear that in this case, anyway, the legislation needs to be reviewed, and regulations clarified and advertised through an awareness campaign by the authorities.

Similarly, the Litter Prohibition Act is often ignored by both young and old, because of either ignorance of perceived immunity from prosecution. Whether the lack of enforcement is a deliberate policy of the ministry responsible, or whether the legislation and prescribed penalties are inappropriate, is open to discussion. The method and degree of enforcement and imposition of penalties need to be broadly re-considered in view of the apparent general attitude of the Nauruan people, and some lateral thinking applied to find solutions.

The review of the environmental aspects of these separate pieces of legislation is needed, to facilitate their appropriate administration and enforcement. It is suggested that new legislation will be required in a number of areas, including the possibility of a single Act that expresses the Government's overall environmental management and protection policy. Nauru's obligations under international agreements may provide guidelines for the writing of such Policy and Legislation.

There is also a need for external funding for the development of government environmental infrastructure, to review and strengthen environmental legislation, and to strengthen environmental human resources in the country. These initiatives are discussed in Programs 3.7 and 3.8 in the NEAP.

4.4 LOSS OF BIODIVERSITY

Given the long history of degradation due to mining, and the heavy devastation and displacement of people during World war II, Nauru has probably suffered greater loss of biodiversity, in terms of ecosystems, species and varieties of plants and animals than almost any other country in the World.

4.4.1 Loss of Ecosystem Diversity

The Forestry Component of the NACRDFS (1994) found that only 37 hectares remained of the original Topside *Calophyllum* forest, and that even this is in danger of being lost to mining. Similarly, because of the pressure of residential development, Bottomside sites were found to contain very little surviving natural vegetation. It was concluded that some of these remaining natural areas and their component ecosystems should be preserved due to the high

cost and uncertainty of revegetation programs to recreate the original ecosystems and forest types of Nauru.

There has also been significant loss of ecosystem diversity and ecosystem degradation in the marine environment. This is discussed in more detail under Issue 4.5 below.

It was suggested by the NACRDFS that the preservation of examples of original ecosystems could be achieved through some form of Conservation Zones. This is seen as being of the very highest priority for the rehabilitation process. Priority sites for forest protection and management should be those showing the least level of disturbance, the highest species richness, the greatest numbers of rare or endangered species, and the most value as wildlife habitat, with particular emphasis on those species important as noddy bird rookeries. Special consideration should also be given to those areas containing culturally important and useful plants, such as coconut, breadfruit and Pandanus cultivars, mangroves, Pisonia grandis and other species that comprise the main noddy bird rookeries. these programs are discussed under Issue 4 in the NEAP in Chapter 5.

4.4.2 Loss of Species Diversity and Species Endangerment

One consequence of the reduction in area of natural vegetation is that some of the less common species of plants and animals have become very restricted in either distribution, or in the numbers of individuals in their remaining populations. As a result, up to 45% of Nauru's indigenous plant species (27 out of 60), and a significant proportion of bird species, are considered to be rare or endangered. While these species, with the exception of the endemic Nauru canary, are not restricted to Nauru, it is likely that their populations have been isolated for some time, and contain unique genetic material. In addition, many culturally important trees and other plants and plant varieties have been lost or reduced to a few individuals. These also need to be protected and conserved.

These rare or endangered species will become extinct or extirpated if the recent trends in reduction of their populations continue. Some species and varieties that were known by older Nauruans (such as enga and Pandanus varieties) are no longer found in Nauru, and are presumed to be extinct or extirpated. For this reason, it is also suggested that special programs be established to identify, register and conserve or preserve endangered species and varieties of Nauru's plants and animals. Some of these are discussed in Programs 4.1 to 4.6 in the NEAP.

The declining populations of noddy birds (Anous stolidus) are of particular concern. The hunting and ceremonial consumption of these birds is extremely important to the Nauruan culture. Their numbers are apparently in decline, reportedly due to a combination of increased hunting and the destruction of their breeding and nesting areas due to mining and other development along the escarpment (see Program 4.6).

4.5 CORAL REEF AND MARINE RESOURCE DEGRADATION AND OVEREXPLOITATION

Marine resources are of critical long-term subsistence and commercial importance to the people of Nauru. Degradation and overexploitation of the intertidal zone, subtidal coral reefs, reef-slope and pelagic (open ocean) fisheries resources is seen as a major constraint to sustainable development. This concern was strongly expressed during a recent "Conservation of Fish Stocks and Marine Environment Workshop" hosted by IDI (Deiye 1995). There is, however, little scientific information concerning maximum sustainable catch, and resource profiles and the extent of over exploitation of specific marine resources.

Some of the most important issues or include:

1. Overexploitation of inshore and reef slope resources.

2. Breakdown of traditional marine tenure systems and resource-use systems.

3. Inability to optimally exploit pelagic and deepwater fisheries resources.

4. Breakdown of the traditional aquacultural system.

To address these issues will require a range of programmes and activities which are discussed in Programs 5.1 to 5.4 in the NEAP in Chapter 5.

4.5.1 Overexploitation of Inshore and Reef Slope Resources

Increasing population, commercialisation, and the use of motorised fishing boats and more efficient modern fishing techniques, and the use of some destructive fishing techniques, have placed great pressure on Nauru's limited inshore and reef-slope fisheries resources.

The lack of regulation of the traditional reef and inshore fisheries, is of special concern. Increasing harvests of many food species in these zones, for rapidly expanding local urban markets and for subsistence consumption, have led to the depletion of these resources.

Traditional taboos and marine tenure systems, which have been responsible for relatively sustained-yield production over thousands of years, have been largely abandoned. The widespread use of small-mesh and extremely long gill-nets, increased spearfishing, especially night and SCUBA spearfishing, are now rapidly degrading important fisheries resources. A number of line fishing methods, including the multiple-hooked "Christmas tree" fishing and underwater linefishing by divers are also very efficient fishing methods. SCUBA spearfishing, in particular, which is banned in many Pacific countries, has shown to put excessive pressure on deepwater reef and reef slope stocks. These deepwater stocks have in the past served as the nurseries and sources of breeding stock responsible for repopulating or recruitment for more intensively exploited shallow areas. Also of concern has been the use of crowbars and excessively long gillnets (known locally as "Great Wall of China Nets" by members of the expatriate community, the use of gillnets by the Kiribati community to catch flyingfish and the killing of dolphins by the Kiribati and Tuvaluan communities.

Finfish species of nutritional and cultural importance which already show evidence of overexploitation include:

1. a wide range of shallow- and deep-water water snapper, rockcod, grouper, or coral trout species (Lutjanidae)(*Cephalophlis*, *Epinephelus* and *Lutjanus* spp.)(**eanape, earata, earo, eaurur, ianen, ianit, kawudo**);

2. squirrelfish or soldier fish (Holocentridae) (*Adioryx*, *Holocentrus*, *Holotrachys*, *Myripristis* and *Sargocentron* spp.)(**eabanginab, ebo, emwan**);

3. lined bristletooths (*Ctenochaetus striatus*)(**iwiyi**);

4. large moray eels (*Gymnothorax flavimarginatus*)(**etorobwiy)**; and,

5. lobsters (*Panularius* spp.)

Daily reef gleaning on the intertidal flats by increasing numbers of Nauruans and non-Nauruans, has reportedly led to the overexploitation of turban shells (**emwari**)(*Turbo setosus* and *Turbo argyrostoma*), the most important shellfish protein resource on the island. Octopus are only abundant during and after drought, possibly in response to increased salinity off the island.

The pelagic (free-swimming, often migratory species) or deep ocean fishery is almost universally underexploited, despite years of exploitation by American and east-Asian distant-fishing powers. At present, Nauru has not successfully developed its own distant-fishing capability, although the Nauru Fishing Corporation exists for this purpose.

It is clear that because of catch increases due to increasingly efficient and/or destructive technology, the capability to manage the fishery must also be strengthened. The most effective way to implement this is by regulation, based on a scientifically determined maximum sustainable catch (MSC). This will require, however, better "resource profiles" on the population dynamics of Nauru's fisheries resources. The types of information that are required are discussed under Program 5.2 in the NEAP in Chapter 5.

Since MSC figures are not available for most species, there is a need to implement some programmes that could generate such information and promote the sustainable use of fisheries. Six programmes that are suggested under Objective 5 in the NEAP.*** **include: the establishment of marine reserves and limited entry areas, the banning of inappropriate fishing technques such as SCUBA spearfishing, putting limits on the length and mesh-size of nets, the use of closed seasons, setting size and number limits on given species, the limiting of commercial fishing for certain species or areas, public awareness campaigns, and the promotion of increased reliance on pelagic resources. All of these posibilities are suggested and were strongly endorsed by the "Conservation of Fish Stocks and Marine Environment Workshop" (Deiye, 1995). These programs are discussed in the NEAP in Chapter 5 below.

4.5.2 Breakdown of Traditional Marine Tenure and Resource-Use Systems

Traditional fishing rights in Nauru carried with them the responsibility to husband the resource. This responsibility was adhered to when traditional fishing methods were used to make sure that there would always be some fish to catch - for there was no cooperative supermarket to turn to if the fisherman was unsuccessful! Today, however, these rights, including right to establish enge (traditional aggregation devices) in the intertidal zone, and the responsiblity of other Nauruans to respect enge, have been lost or are being ignored.

Part of this lost of respect for traditional fishing rights and the adoption of unsustainable fishing methods has been atributed to the loss of traditional knowledge about the marine ecosystem and about fisheries resources. This is also seen as an important issue that need to be addressed by the NEAP.

4.5.3 Under-exploitation of Pelagic and Deepsea Fisheries Resources

The inability of Nauru to optimally exploit its pelagic and deepsea fisheries resources was seen as a major development challenge and an area of priority development. Most notable was the failure of the Nauru Fishing Corporation, the loss its fish aggregation devices and the failure to optimally capitalise on the deep-water demersal resources and the sashimi export market. Programs to address this issue are suggested in Chapter 5.

An associated problem, in terms of shifting fishing pressure to the more distant offshore resources, is a very high incidence of small fishing vessels in distress or lost at sea (reportedly 40 to 50 in 1989-90). This has resulted from the increasing use of outboard-powered craft instead of traditional paddling or sailing canoes, and has involved considerable expense, in terms of search and rescue, and loss of life. The main causes are poor engine maintenance and engine failure, overloading, running out of fuel after chasing tuna schools, and rain squalls that obscure the islands (McCoy, 1991). An outboard maintenance workshop in early 1996 was an initiative to address this issue.

4.5.4 Breakdown in the Traditional Aquacultural System

One of the most important fishery issues in Nauru concerns the breakdown in the traditional milkfish (*Chanos chanos*)(**ibija**) aquacultural system due to the introduction and domination of milkfish by tilapia (*Oreochromis mossambicus*, formerly known as *Tilapia mossambica*). Gillett (1991) reports that pressure to quickly produce substantial development results caused the benefits of tilapia to be oversold while under-estimating the risks. The tilapia, which were introduced by SPC to virtually every island group in the Pacific Islands with the exception of Norfolk and Pitcairn, were so "successful" that the fish displaced the highly esteemed milkfish. However, the new fish were not well regarded by Nauruans. By the early 1980s a priority fisheries project on Nauru was tilapia eradication. A UNDP project attempted to do so (Ranoemiharjo 1981) but was not successful due to the large size of the lagoon.

A later FAO project attempted to partition small areas of the lagoon, and poison the tilapia. The plan was to gradually fence off and incrementally poison the whole lagoon. It too was not successful, supposedly due to problems with the erosion of the embankment of the enclosed area and difficulty of poisoning the tilapia eggs in the mud.The rehabilitation of the lagoon is of great importance to the members of the Pond Owners Association, who are currently investigating the possibility of introducing a predator species to assist the removal of tilapia.

4.6 PEST AND DISEASE INFESTATIONS

The current lack of Quarantine Regulations and facilities in Nauru is an issue that is of wide concern. Although the Animal Act of 1982 empowers Cabinet to prohibit the importation of any animal species, there are strong environmental arguments to extend this provision to plant species and marine organisms, and indeed to strengthen the existing regulations and their enforcement. At this point in time, pest and disease organisms (whether plant, animal or microorganism) can be introduced un-checked to Nauru through air and sea transport terminals. This has not been regarded as important in the past few years because most consumables were imported, and there was little agriculture that it was deemed necessary to protect. This has no doubt resulted in the accidental importation of several pest species such a range of aggressive weeds and a number of fruit flies.

For example, introduced weed species are very common on newly disturbed areas of topside, and some parts of the existing indigenous escarpment forest appear to be threatened by competition from introduced tree species, such as the red-bead tree (*Adenanthera pavonina*).

Of particular concern is the distinct possibility that the brown tree snake (*Boiga irregularis*) could be accidentally introduced, via Air Nauru, from Guam, where it has consituted and national environmental disaster. In Guam, it has devastated local bird, bat, skink and gecko populations, constitutes a danger to children and has caused frequent electrical power failures. It has also caused sea birds to stop nesting in Guam. Already live and dead snakes have reached Diego Garcia (in the Indian Ocean), Saipan, Tinian, Rota, Okinawa, Oahu, Kwajalein and Texas from Guam by air.

Anecdotal evidence also suggests that Nauru is suffering from an increase in population of pests and disease vectors such as flies, mosquitoes, cockroaches, rats, feral dogs, cats and pigs. The NIC Annual Report of 1993 listed fourteen species of fruit fly, moths, mites scale insects, snails, beetles, weevils, borers, and termites as being observed by their personnel in the previous year. These animals impact on both the urban and natural environments, and can reduce the quality of life for Nauruans by spreading diseases. Accordingly, a program of pest and disease control and the establishment of a Quarantine Service are recommended in the NEAP, to address the issue of pest control which will take on increasing importance if Naurus are required to become more reliant on local agricultural production in the future.

Also of concern is the possibility of introducing serious pests or diseases into the marine environment in the ballast or bilge water brought into Nauru in phosphate vessels. Experiences from other parts of the world show that organisms introduced via bilge water have had

disastrous effects on marine organisms, and could have disastrous effects on the entire marine environment and food chains of Nauru.

4.7 POLLUTION AND WASTE MANAGEMENT

The issues of air, noise, oil and water pollution and waste management are foremost in the minds of many Nauruans and were consistently raised as concerns at all levels of consultation. It was recognised that both pollution and waste affect the natural and urban environments, and especially human health. The increase in pollution and the waste stream will require strategies for prevention and management at all levels of Nauruan society, from the individual, household and community levels to the national level. The main areas of concern are solid waste management, water pollution and sewage treatment, and air and noise pollution.

4.7.1 Waste Management (Solid and Liquid)

With population increase and the consumption of imported consumer goods, the issue of solid waste disposal on Nauru has become serious. All households and activities in Nauru are producers of solid wastes, such as food scraps, packaging, plastic, glass and metal containers, garden waste and garbage of other kinds. Pollution from the un-controlled disposal of such solid wastes contaminates groundwater, causes the spread of pests and diseases, and air pollution through burning and generation of toxic and greenhouse gases.

At present, the collection of garbage is undertaken partly by each of NIC, NPC and PWD, but collection is irregular and not all households are serviced because the service is voluntary.

There is also a problem with the future of the existing landfill site, and what will happen to it when land rehabilitation commences. The problem relates to the fact that the landfill has been uncontrolled with respect to compaction and burying of organic matter that will continue to decompose and form methane gas for many years. This decomposition will also result in the formation of liquid leachate that will pollute the groundwater system. This will render the land unsuitable for any other purpose, including participation in the rehabilitation process.

A new landfill site needs to be found soon, to be designed and managed according to modern principles, if only for the sake of limiting the on-going damage to the existing landfill site, and on-going pollution of groundwater and other impacts (see also the NACRDFS Environment Report). For example, the pollution of the groundwater under the island and of rainwater storage systems is restricting the availability of water supply from these sources. This pollution was perceived to be caused by the inadequate disposal of solid waste and leakage from the sewerage system.

Pollution from toxic chemicals, such as fuels and lubricants, paints, solvents, heavy metals, pesticides, fungicides and other industrial chemicals is also of concern. In fact, the importation of pesticides and other chemicals to Nauru should be controlled by regulations that

include product safety data sheets, correct and complete labelling, and recommendations for use with special equipment, in accordance with best international practice.

The storage and waste disposal of fuels and lubricants has been recognized as both a current and potentially more serious future pollution issue. NPC currently imports and distributes all fuels and lubricants, but no facilities are available for recycling or safe disposal. The cadmium "slime" dump near Buada Lagoon is of some concern in this regard, although further studies need to be carried out regarding the extent of the threat of cadmium disposal to human health and the environment.

Bio-wastes from medical facilities have, at times, been burned at the landfill site, due to operational problems with the Hospital incinerator. Such wastes need to be separated from the general solids, and a suitable incinerator established at the new controlled landfill site, away from residential sectors.

It is therefore recommended in the NEAP that an efficient integrated waste management program designed to both reduce the "waste stream" by recycling where possible and to dispose of solid waste in a more environmentally friendly way.

4.7.2 Water Pollution and Sewage Treatment

The pollution of groundwater from leachates and human waste was referred to above. Other perceived sources of water pollution in Nauru include the phosphate dust from the loading process that settles on nearby roofs and is washed into storage tanks, and poor maintenance of storage systems.

The NACRDFS report concluded that:

The groundwater resource of Nauru is one of the country's greatest assets. Once changed by the entry of pollutants into groundwater, however, there is no way of reversing the situation. For this reason it is of fundamental importance that activities in areas from which water enters into the underground storage are not polluting activities. Some groundwater is already polluted - by human waste. This is revealed in some of the wells at the foot of the cliffs skirting topside. It is important to avoid further environmental change to this resource through pollution.

The solution to eliminating biological pollution from this source lies in the adequacy and management of the sewerage system. The existing situation of raw sewage discharge over the reef is described above, and a recommendation for the establishment of a Sewerage Treatment System is discussed under Program 7.5 in the NEAP.

The discharge of raw sewage across the reef is also of concern. This comes from at least three sources: 1) houses and public buildings in the vicinity of NPC that are connected to a sea water based reticulated sewage; 2) disposal through a piped outfall of sewage from individual septic tanks and cess pits which are emptied on a regular basis or when needed; and, 3) the discharge of sewage by pipe over the reef from Nauru General Hospital.

4.7.3 Air Pollution

Although a minor issue, air pollution due to the possible harmful effects of phosphate dust and of motor vehicle emissions (especially through the use of leaded petrol) warrant some concern.

The possible health implications of phosphate dust, particularly in areas near the decalcination plant and the loading area near the cantilevers, is also of concern. Although no direct medical problems have been reported, there is some belief that excessive levels of phosphate dust pollution are detrimental to human health in terms of respiratory or eye problems. There is, however, sufficient information on this matter to recommend that the levels of these pollutants be monitored and that all practicable measures be taken to reduce their intake by humans. In particular, the health of workers in the affected areas needs to be closely monitored.

4.7.4 Noise Pollution

Noise pollution, in connection with airline operations, was seen by some residents as a problem, especially in Boe and Yaren Districts which are adjacent to the airport. The importance to Nauru of the Airline and the relatively infrequent flights suggest that this is not of high priority, except possibly in connection with the nuisance to nearby Schools. There is also some concern for excessive noise due the use of high-powered stereo amplifiers or "ghetto blasters" by some households and vehicle owners. Although a number of studies show that excessively loud music damages hearing, affects work efficiency and can cause minor stress, few Nauruans see this as a major issue. In fact, during the annual Independence Celebrations there is a national "Battle of the Sounds" competition for the loudest sound system.

4.8 POPULATION GROWTH AND URBANIZATION

Population growth and urbanisation put increasing pressure on natural and cultural resources and constitute a major constraint to sustainable development in Nauru. Although the devastation of the Nauruan population during World War II was cause for a conscious policy to have large numbers of children, it is clear today, in 1996, that there is no longer a need for such a policy. There are already clear signs of land shortage and increasing population pressure on scarce resources, such as water, noddy birds and marine resources. Unless there is a deliberate policy to stabilise current population levels, few of the problems associated with land and housing shortage, land fragmentation, water shortage, overexploitation of marine resources, or those related to pollution and waste disposal can be addressed.

Uncontrolled urbanisation is another indication of increasing population density and declining productivity of the land. Most of Nauru's people now live urban lifestyles. This has led to the loss of traditional knowledge about the plants and animals and the environment and an abandonment of subsistence lifestyles. Increasing cash employment and unemployment (people who neither have urban jobs nor produce things for themselves) and increasing dependence on

imported foods, beverages, entertainment (e.g., videos and music) have led to social problems, and increasing consumption of nutritionally-inferior highly processed foods and alcohol.

From an environmental and cultural perspective, urbanisation has not only put pressure on and polluted the Nauru environment, but has also produced a current generation of Nauruans who know little traditional environmental knowledge. This knowledge is now dying with the last of today's older people.

4.9 HEALTH AND NUTRITIONAL DETERIORATION

The state of health and nutrition in a country is an important indicator of social and environmental well-being and development. Without good health, there is limited incentive for people to worry about maintaining a healthy environment around them. Although the people of Nauru are generally well-fed and healthy, there are serious nutritional problems and health disorders, most of which are related to changes in resource use systems, increasing population densities, and urbanisation.

Recent studies in Nauru have recorded among the highest incidence of diabetes in the world (almost 66% of adults are affected by diabetes by the age of 55), as well as very high incidences of obesity, hypertension (high blood pressure), hyperuricaemia (often manifested as acute or chronic arthritis and gout), diseases of the digestive system, cirrhosis of the liver, and certain forms of cancer. All ranked high in, or were contributory to the major causes of premature death in Nauru, with diabetes accounting for 25% of all non-accidental deaths between 1983-85. Dental and periodontal disease is also increasingly common in Nauru. The studies show strong correlations between increasing incidences of these diseases and the increasing consumption of imported foods and beverages (which are high in sugar, salt, alcohol, animal fat and low in vitamins and minerals and fibre), smoking and a sedentary urban lifestyle (Rubinstein and Zimmet 1993).

Accidents and injuries have also become a major cause of death since independence. These are almost entirely related to traffic accidents, mostly alcohol-related. Evidence shows that the rapid change in lifestyle, with the imposition of a foreign culture, is an important factor producing stress and social conflict, especially among the young people of Nauru (Rubinstein and Zimmet 1993).

Influenza, historically responsible for devastating epidemics throughout the Pacific, is still a common infectious disease. The true incidence would undoubtedly be much higher, if non-reported cases were also included.

There are high rates of infantile and adult diarrhoea in Nauru, and other gastrointestinal problems constitute a health problem. With increasing population densities, the situation could worsen in the future.

Skin diseases, such as tinea and ringworm, are common, and are present both among Nauruans and contract workers. These may be caused by poor personal hygiene and inadequate water supply. Hepatitis-B is also present and constitutes an area of concern.

One of the most serious health problems is the almost epidemic outbreak of venereal or sexually-transmitted diseases (STDs) in some Pacific countries. The situation is particularly serious in urbanised areas of Papua New Guinea, New Caledonia, Fiji, French Polynesia, the Federated States of Micronesia, Palau and the Marshall Islands, all areas with regular air links with Nauru. Particularly alarming is the increase in penicillin-resistant strains of gonorrhoea and the increasing occurrence of the incurable and ultimately fatal acquired immune deficiency syndrome (AIDS), which is now widespread in the Pacific. An increasing number of cases have been reported from Saipan, American Samoa, French Polynesia, Fiji and Papua New Guinea.The situation does not seem to be as bad in Nauru, although there are signs of increasing incidences of STDs. There have, as yet, been no cases of AIDS reported, although the potential for an outbreak of AIDs in Nauru is great and would constitute a serious threat to the health of the nation and a constraint to sustainable development.

In most cases, the high incidences of these diseases are related to poor management of scarce water resources, poor nutrition, overcrowding and poor environmental hygiene, and the lack of ability to provide adequate primary and secondary health services. It is recommended that systematic programs for health and nutrition improvement and a physical fitness campaign be implemented immediately. These are discussed under Objective 9 in Chapter 5.

4.10 ECONOMIC VULNERABILITY AND INSTABILITY

Nauru's economy is directly linked to that of her major trading partners and, increasingly, to the global cash economy. Most important, is that markets for Nauruan phosphate have not been exempt from the effects of global recession. This has increased the vulnerability and instability of Nauru's primary source of foreign exchange. This issue is of great concern to both the Government and people of Nauru.

Moreover, Nauru has become increasingly dependent on imported manufactured goods, while continuing to export only phosphate. This has resulted in the inevitable deterioration in terms of trade, where the phosphate income has been returned to our trading partners for the increasingly expensive purchase of goods and services.

Unfortunately, Nauru currently has no alternative industries to buffer the deterioration of phosphate income. Nauru's investments from twenty-five years of phosphate mining are earning interest, but the sustainability of this interest depends on the quality of the portfolio and on many other external factors, most of which are beyond the control of Nauru. Factors such as the property market crash of the late 1980s can have a major effect on both the capital value of assets, and their ability to provide an adequate return on the investment.

Some light industries are currently being established in Nauru to supply local demand for consumable products such as soft drinks, and limited export potential is being developed. However, these projects currently rely on the funding from NPC cash flow, import of raw materials and packaging, are heavily dependent on imported energy inputs, and do not capitalise on Nauru's natural strengths and internationally competitive advantages.

Because Nauru can do little about economic factors beyond its control, there is a need maximise self-sufficiency in basic needs, such as marine foods and a limited range of local agricultural products, and to identify commercial development alternatives that do not rely on the exploitation of non-renewable resources. Such developments, plus the wise use and management of the money capital from past and future phosphate revenues could form the basis for a new sustainable approach to development that looks at environment and economy as if they are two sides of one coin. Without a healthy environment, economic development, for both subsistence and commercial purposes, can not be sustainable. And, without some form of economic development and cash income people are unlikely to use their scarce environmental and subsistence resources in a sustainable manner.

In the subsistence sector, the promotion of sustainable fishing activities for local consumption, the re-establishment and rehabilitation of coconut plantations, the planting of a range of appropriate fruit trees and vegetables, and the maximisation of local the production of a limited range of other products and material possessions, could lead to increased local self-sufficiency. In the commercial sector, marine resource and tourism development seem to offer the best prospects in terms of success and sustainablity. The sustainable development of Marine Resources is discussed in more detail in Objective 5 below, and is undoubtedly of great potential for Nauru. Tourism, however, is commonly regarded as providing one of the most exciting opportunities for sustainable development and job creation in the Pacific, and many countries including Nauru have already progressed greatly in this field. Programs 10.1 and 10.2 of the NEAP deal with the development of a Tourism Master Plan and of ecotourism for Nauru.

Nauru's economy is extremely vulnerable which limits its autonomy to follow its own strategies to promote sustainable development. Key constraints contributing to this situation include: increaingly poor fiscal integrity, reliance on a single export, phosphate, heavy dependence on imported food and other products such as fossil fuel.

In terms of fiscal (financial) integrity, Nauru has only limited local economic productivity (in terms of cash) apart from phosphate and earnings from its reserve fund and overseas investments have recently been either mismanaged or overspent which has led to increasing inability of the government to mount new initiative.

The economic implications of increasing food dependency are also serious, a situation which augers poorly for the future given the limited productivity of post-mining Nauru,, with its existing population unable to feed itself from available land and sea resources. Should the supply of imported food be cut off, some people could literally starve.

Other, often related economic problems, which auger poorly for sustainable development, include increasing income disparity within Nauru, rapid inflation and increasing unemployment.

4.11 INADEQUATE DEVELOPMENT INFRASTRUCTURE AND SERVICES

The provision of infrastructure and services is vital for the quality of life in Nauru. The way in which services, such as roading, drainage, electricity and water, are planned, built and

maintained has the potential to severely impact on the environment at the level of the individual family, the district and the nation. Many individual Nauruans raised environmental issues that were of concern to them.

This Section attempts to look at the provision of infrastructure and services from the point of view of their impact on the environment, how they are being provided, and what problems are perceived to exist in relation to their provision. Possible solutions to these problems are discussed in Programs 11.1 to 11.5 the NEAP In Chapter 5.

4.11.1 Services Providers

The main responsibility for the development and maintenance of infrastructure and delivery of services in Nauru is divided between the MWCS, NPC and NIC (see also Section 3.1 above). At present, these agencies often act independently of one another. The issue of coordination is one that the NECC may address, through the establishment of an Infrastructure Working Group. This will be essential in planning for expansion of housing in both existing and proposed areas. It is recommended that an inter-agency committee be established to coordinate infrastructure and services planning.

The ability to plan ahead for the provision of modern standards of service is hampered somewhat by the uncertainties associated with land tenure, and the inability of Government to acquire easements for right of services passage. The agreement of landowners must be obtained before any works are carried out on their property, even for their own or the common good. Delays in work are frequent when negotiations fail with one or two people, even though the vast majority can see the benefits and support a particular project. It is further recommended that agreement be reached at a National level on the concept of 'easement' or 'right of way' for installation and maintenance of essential services.

4.11.2 Roads

The road encircling Nauru and connecting to the ring road around Buada Lagoon is the main sealed road in Nauru. This road is constructed entirely on private land. In this case the doctrine of "common good" was obviously recognised widely enough to allow construction.

However, a result of this tenure situation is that no allowance was made for a services corridor on either side of the sealed section, and no building set-back (distances behind the road alignment) regulations on construction in the road's vicinity. This has resulted in many houses being built very close to the road, with the result that it is extremely difficult to carry out maintenance of, or make additions to, existing services.

The heavy machinery "on loan" from NPC to MWCS to carry out services repairs may itself cause problems by running over surfaces that are not designed to carry such loads, thus causing further maintenance work or shortening pavement life.

4.11.3 Electricity Supply

The supply of electricity (240v domestic service and street lighting) via overhead powerlines is provided on bottomside by the NPC, who also operate and maintain the power station. The power station itself runs on imported oil.

Around Buada Lagoon, the supply has been run underground at the request of the residents, reportedly because of concern at the possible detrimental effects of the powerlines on the mango trees. The initial cost of installation of underground power is higher than that of overhead lines, but subsequent maintenance costs are reduced, and the safety and visual benefits are obvious. Transformers can be mounted on concrete slabs on the ground where needed, and more decorative poles used where public lighting is required.

4.11.4 Stormwater System

Because the soil surface is so porous in Nauru, run-off from natural surfaces is very uncommon. However, in urban areas where surfaces are compacted or sealed, frequent storms often cause local flooding from concentration of stormwater run-off, particularly from road and roof surfaces.

When the ring road was constructed around Nauru, both high and low points were designed to allow drainage from the road surface to flow efficiently to a number of discharge points. Over time, however, these points become blocked, causing ponding to occur, which is often a serious traffic hazard. Again, because of the difficulty in obtaining permission to carry out works on private land, the problems tend to be "put up with" rather searching for an effective solution (see also the recommendation for a right-of-way above).

This situation also applies to the problem of coastal erosion control and prevention works. If stormwater run-off must be disposed of into the ocean, the pipe carrying the water should be taken across the beach underground and a discharge point located on a solid part of the reef platform where erosion will be minimised. Care should also be taken to position the pipe on a dead part of the reef, and a number of smaller outlets would be preferable to a single large one, to spread the impact more evenly.

Collection of stormwater for subsequent re-use (for example on public and private gardens) would be more preferable environmentally, and would contribute efficiently and effectively to water conservation. The existing underground tanks next to the Civic Centre should be repaired, in this regard, and brought into use for a similar reason. This water is free of charge, and only needs to be collected! It is further recommended that a Strategy be developed and implemented to store as much run-off for re-use as possible. In this case, re-use would be more for livestock and irrigation of crops and gardens, than as a potable supply.

4.11.5 Water Supply

Storage facilities for potable water are restricted to tanks in Nauru, because the extreme porosity of the soil rules out the easy construction of dams or reservoirs. A modern desalination plant has recently been commissioned, using the waste heat generated from the power station. This is the current source of water, delivered to domestic tanks via road transport.

A number of environmental problems are associated with this system. Most notable is the high energy cost of water desalinisation and water delivery. Although the waste heat energy for production would be otherwise lost, the main demand for the power output of the station is the phosphate drying facility. When this facility closes, the demand for energy will cease and the heat energy required for desalination will be lost. A costly replacement source of energy will be needed, unless the power demand is met by the introduction of a different industry or by general industrial and commercial expansion.

NPC currently has plans to build a new 30,000 T storage tank for surplus water produced during wet periods when there is sufficient rainfall to fill household and institutional tanks, and hence eliminate import requirements. Perhaps the economics of this should be compared with those of upgrading the stormwater collection and storage system, both at the household and community levels. In addition, the conservation of water use should be linked to the supply of water, and incentives be given to those households and business who are "waterwise". Full cost recovery should be obtained for all water supply. It is further recommended that an integrated strategy on water conservation and supply be developed for the future.

4.12 GLOBAL CLIMATE CHANGE

Climate change, and in particular global warming and the destruction of the Earth's ozone layer, ia a major concern, not only for Nauru, but for the entire international community.

4.12.1 Global Warming and Eustatic (Worldwide) Sea Level Rise

There is grave concern that the densely populated coastal plain of Nauru could become less habitable as a result of global warming and associated sea-level rise. This has caused serious concern at all levels in the community. Accelerated coastal erosion and increasing salt-spray damage to vegetation and property is already being experienced.

It has been widely predicted that during the next century, there will be a eustatic (worldwide) rise in sea level ranging from a moderate 44 cm to an extreme of 258 cm by the year 2075 due to global warming. IPCC predictions are from 12 to 40 cm by the year 2030 and 30 to 100 cm by the end of the next century. The most recent IPCC summary released in December 1995 reports that there has been a measured worldwide rise in sea level of 15-25 cm since the beginning of the century. Although there have been rises and falls in sea level due to natural global warming and cooling in the past, the rise this time would be faster and due mainly to human activities, the main factor being the accumulation of so-called greenhouse gases (carbon dioxide, nitrous oxide, methane, chlorofluorocarbons, and others) that alter the outgoing radiation and thus affect ocean volume and glacial melting. Although evidence from El Nino phenomena shows that the sea-level near Nauru has risen from time to time as much as 40 cm

higher than its current average level, there is doubt as to whether Nauru could cope with a similar El Nino rise superimposed on higher average levels associated with global warming.

If such a scenario should eventuate, the implications for the small-island states and coastal areas are serious. Some of the potential effects of rising sea levels on low-lying islands and coastal areas include: 1) increased frequency of storminess; 2) increased flooding and inundation of wetlands, coastal agricultural areas and other low-lying areas; 3) increased saltwater incursion and storm overwash into coastal aquifers, freshwater lenses, and agricultural areas; 4) increased destructiveness of unpredictable natural hazards such as tropical cyclones, storm surge, and tsunamis, especially if they coincide with exceptionally high tides, such as the "king tide" that occurred in June 1994; 5) increasingly destructive wave activity and decreased protection from submerged offshore reefs; 6) increased coastal erosion; 7) loss of coastal and mangrove forests; 8) loss of coastal agricultural areas; declining fisheries productivity; 10) increased coral mortality; 11) changes in oceanic currents and upwelling; 12) breakdown in natural community (ecological) interrelationships; and 13) loss of property and structures. Most of these potential effects would have serious implications for Nauru.

Of serious concern to Nauru is that recent studies show increased sea temperature may be a major cause of "coral bleaching" and the death of coral. This has serious implications in terms of the loss of protection that coral reefs provide to the island from the destructive power of the sea and the loss of marine habitats and destruction of food chains for important marine organisms.

4.12.2 Breakdown in the Earth's Ozone Layer

An associated, but separate issue is the breakdown in the Earth's ozone layer caused by the greenhouse gases, chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs). The ozone layer is vital for protecting life on Earth from the harmful effects of ultraviolet radiation. Because the immune systems of living things can be weakened by exposure to ultraviolet radiation, the natural protection against disease in many terrestrial and marine organisms (such as coral reefs) could be affected (Haines 1991). In terms of human habitation of the earth, this could be a far more serious danger than global warming and sea-level rise, particularly in places near the Equator, such as Nauru where sunlight is very intense throughout most of the year. The weakening of the immune system in humans might combine to amplify the effects of communicable and other diseases which are present now, or could be present in the future in Nauru (e.g., AIDS).

Ozone depletion is an ongoing problem, despite the Montreal Protocol banning CFCs in 10 or more years. It is happening faster than any scientist had predicted. It is no longer only a threat in the future. The threat is here and now. It is also too late to prevent the damage, which will worsen in years to come (Lemonick 1992). It is critical that Nauru support all international initiatives to ban the use of CFCs, HCFCs and any other chemicals or activities that deplete the Earth's ozone layer in the hope that ozone loss can be stabilised soon after the turn of the century.

It is also important that Nauru take steps now to protect its inhabitants from overexposure to increasing ultraviolet radiation which in Australia and other areas has led to drastic increases in fatal skin cancers and the weakening of the human immune system.

4.13 RADIOACTIVITY AND NUCLEAR POLLUTION

The Pacific has one of the longest continuous histories of nuclear pollution in the world. There has been widespread testing of nuclear weapons, the continued presence of nuclear vessels and arms, and the past and proposed disposal of nuclear wastes. These must be seen as one of the most serious obstacles to sustainable development, both globally and for Nauru.

The U.S. has tested nuclear weapons on Bikini and Enewetak in the Marshall Islands, the British and U.S. on Kiritimati (Christmas) and Johnston Islands (a U.S. possession) in the neighbouring Line Islands. Most recently, the French have tested over 100 nuclear devices on Moruroa and Fangataufa atolls in the Tuamotu atolls of French Polynesia, and plan on resuming testing in late 1995.

There have been joint U.S. and Japanese proposals for the "interim" storage of 10,000 tons of spent nuclear fuel from Japan, South Korea and the Philippines and two Japanese proposals to dump containers of high- and low-level nuclear waste in the Pacific. More recently, the U.S. has continued, as part of a "huge war dump burn-off" to burn millions of litres of toxic nerve gas and dispose of other dangerous weapons at a $US150 million "chemical warfare base" on Johnston Island, despite strong objections by the nearby Marshall Islands and Federated States of Micronesia, Kiribati and the other independent states of the Pacific Ocean. In spite of the opposition, the US military has already begun operations.

The proven danger of such activities to the oceanic and island environments and the fatal somatic (to generations directly affected) and genetic (to future generations of affected individuals) damage induced in living organisms is widely documented (Thaman 1988a).

In short, the long-term, the almost certainly irreversible environmental and human damage that has and will continue to result from the use of nuclear technology and other military activities in the Pacific, is one of the most crucial environmental issues affecting sustainable environmental development in the entire Pacific Ocean.

Nauru's continuing strong concern over this issue is shown in its record of support for all international and regional anti-nuclear initiatives. A suggested in Program 18.1 in the NEAP, this stance should be continued.

4.14 INTERNATIONAL TRAFFIC IN TOXIC AND HAZARDOUS WASTE

Until recently, highly industrialised countries were virtually free to dispose of wastes, either too toxic, too hazardous or too expensive to dispose of in the countries of origin, in developing countries. In the past, if boats were available, there was always someone willing to arrange disposal in some unsuspecting developing country. As most developing countries are

now refusing to accept toxic and hazardous waste, increasing focus has been placed on the Pacific Islands and the expansive Pacific Ocean a potential sites for dumping or treatment of these wastes.

Toxic wastes, which are considered too toxic, too hazardous or too costly to dispose of or recycle in many industrialised countries include clinical medical wastes, pharmaceutical wastes, pesticide wastes or banned pesticides, waste organic solvents, cyanide wastes, waste mineral oils (e.g., fossil fuels), tars, asbestos, industrial wastes contaminated with PCBs (polychlorinated biphenyls), PCTs (polychlorinated terphenyls), PBBs (polybrominated biphenyls) and CFC (chlorofuorocarbons), fertilisers and other wastes with heavy metal contamination, dyes, pigments, resins and lacquers, plastic wastes, photographic chemicals and vehicle tyres. Nuclear waste, nerve gas, ammunition, explosives and other military wastes could also be added to this list. All of these, by virtue of the fact that their disposal is banned or restricted in many producer countries, indicates that they are all potentially very hazardous to sustainable development in the fragile island environments and fluid ocean environment of the Pacific.

The Pacific Forum countries have collectively shown their concern over the trade in toxic wastes at the South Pacific Forum Meeting held in Nauru in 1993 where the 15 member countries endorsed a proposal from Papua New Guinea to ban waste imports into the region. This proposal, to which Nauru is a signatory, has now been formalised and is known as the Waigani Convention (1995)(South Pacific Forum Secretariat 1995). The main strategy recommended to deal with the unethical, often illegal and extremely environmentally dangerous trade in toxic and hazardous wastes is for Nauru to maintain its continued strong stance against such activities and to support all regional and international initiatives, like the Waigani Convention to ban the trade of toxic wastes.

CHAPTER 5
NATIONAL ENVIRONMENTAL ACTION PLAN

This chapter is a National Environmental Action Plan (NEAP) for Nauru. It is the most important part of this National Environmental Management Strategy. The NEAP consists of a range of Objectives and associated Programs under each Objective that could be implemented to address the main environmental issues and constraints to environmentally sustainable development. The programs are not necessarily listed in order of importance, although some, such as the rehabilitation of the mined-out areas of Nauru, the strengthening of environmental awareness and education, the strengthening of environmental infrastructure planning and environmental legislation, the protection of endangered terrestrial and marine resources, and waste management are all seen as essential to the promotion of environmentally sustainable development on Nauru. Consequently, many of the suggested Objectives, such a rehabilitation of the mined-out areas, the strengthening of environmental education, or the establishment of protected or conservation areas, and the specific Programs suggested under these objectives, may simultaneously address two or more issues.

It must also be stressed that while some programs and activities will require outside funding and expertise, others can be implemented immediately by government or by the local community or individual landowners and citizens. When possible the agencies that could be responsible for specified programs and activities and potential sources of funding and expertise are identified.

OBJECTIVE 1: LAND REHABILITATION AND PROTECTION

The rehabilitation of the mined-out phosphate lands is the number one priority in Nauru in terms of the promotion of sustainable development. Also important is the degradation of un-mined land through localised inland and coastal erosion, which is a problem of increasing concern.

PROGRAM 1.1 REHABILITATION OF THE MINED-OUT PHOSPHATE LANDS

Agencies Responsible: Nauru Rehabilitation Authority (NRA), Department of Island Development and Industry (IDI), and the Nauru Phosphate Corporation (NPC)

Potential Funding Sources: Nauru-Australian Cooperative Agreement Fund, Nauru Rehabilitation Fund, Government Finances, NPC earnings, AusAID, USP and other sources or agencies for individual components of the rehabilitation process.

Potential Sources of Expertise: NRA, NPC, AusAID, and other sources/agencies for individual components of the rehabilitation process.

Nature of Program: The rehabilitation of the mined-out phosphate lands of Nauru will be a massive long-term operation, and must be seen as an independent activity from the rest of the programs and activities proposed under the NEAP. It is, however, listed in the NEAP as THE priority program, for the sake of completeness.

The eight volumes of the 1994 Nauru Australia Cooperation Rehabilitation and Development Feasibility Study (NACRDFS) provide an extensive amount of information and constitute a mechanism to mine residual phosphate deposits, reinstating the topography, replacing a soil profile, and revegetating the mined land according to a detailed land-use plan. These documents, which include an environmental component, should be made available for reference to the members of the National Environmental Coordinating Committee. Only a summary of the activities proposed by NACRDFS is provided here to give some insight to the nature and scale of the proposed activities for rehabilitation.

A vital first step in the implementation of the rehabilitation is the NACRDFS recommendation for the establishment of a Nauru Rehabilitation Authority (NRA) which would have control over the process and programming of the rehabilitation of Topside, and by implication would be responsible for any residual and secondary mining (possibly using NPC as a sub-contractor?).

The NACRDFS has suggested 12 land uses for Topside after rehabilitation. These are: 1) roads, 2) a cemetery, 3) housing, 4) a hospital complex, 5) agroforestry/residential, 6) an industrial complex , 7) sports/recreational/parkland, 8) airport, 9) an education complex, 10) water storage, 11) a public service complex, and 12) conservation.

Under the proposed NACRDFS land use plan, sites for housing will meet demands for the next 80-100 years, there will be roads and space for offices, education, industry, parks, gardens, sports and recreation, new forests, water storage and conservation. Uncommitted land for siting an airport and its future expansion is also included in the plan. Nauru will emerge as a land rich country, relative to its current population. Some of the activities and considerations related to the proposed rehabilitation under the NACRDFS are discussed briefly below

Pinnacle Levelling

To implement the land use plan, pinnacles will be levelled on 1,295 ha, using a large excavator and bulldozer levelling 60 ha/year for an estimated cost of $51,000/ha. Allowing time to run more trials on the machinery, $66 million will be required over 23 years to meet the pinnacle levelling costs.

Mining

Land mined by machinery after 1946 (land mined prior to this was mined by hand) retains an estimated 12,000 T/ha of ore between the pinnacles. 75% can be retrieved by mining in association with pinnacle levelling, using excavators and grab machinery with a small suction miner working from a platform of levelled pinnacles.

The cost of residual mining is estimated at $30,500/ha. If 50% was suitable for export its cost would be $5.10/wet tonne. Excluding Conservation Areas and land mined more efficiently prior to 1946, the total cost of residual mining amounts to $40 million. If FOB prices for phosphate were $30-$40/T, a small marginal net revenue of $10-20/T could be obtained, depending on NPC costs for hauling, crushing, drying and loading. This revenue would be available for distribution or returned to Government to offset the cost of rehabilitation.

Processing

Traditional markets are at risk because of the high cadmium content of Nauru rock phosphate. The future of mining lies in new markets (in Asia) or new processes (the production of dicalcium phosphate). Both avenues require further research but production of dicalcium phosphate does offer potential for the Nauru industry.

Use of Pinnacles

In terms of the possibility of selling the removed pinnacles, market penetration will be difficult. However, with joint venture partners with technical expertise and market reach there is limited scope for the marketing of polished stone, dolomite fluxes and aggregate.

Soil Creation

All land designated for revegetation will require a soil profile which can be created in Nauru without importing foreign material. The topsoil stockpiles are enough to give about 500 ha sufficient depth to support forest with the remaining land receiving a thinner layer for grasses and shrubs.

Subsoils are to be obtained using aggregate from crushed pinnacles and residual phosphate unsuitable for export. Costs for soil creation vary depending on the constituents, costing $124,500/ha (or $63 million for 500 ha) when 25% of the residual phosphate reserve is available (The most expensive material in the profile is the aggregate).

In order to increase topsoil stocks it is recommended that Nauru embark on a National Program of soil creation through waste management, collecting and composting all organic waste (this is discussed below under NEAP Program 1.3).

Conservation Areas

Five areas have been identified as having natural resources which require land use controls to retain their aesthetic and historic value as well as their importance as habitats for rare and endangered species, i.e., as sites for biodiversity conservation. Three areas are to be retained in their natural state (the East Coast Escarpment above Anibare Bay, Command Ridge and Buada Lagoon) and two require some reforestation (Topside Tomano Forest; West Coast Escarpment). These areas and additional sites suggested during the NEMS study are discussed below under NEAP Objectives 4.1-4.4.

Reforestation

In addition to the designation of Conservation Areas, reforestation is required in association with housing and agroforestry. The indigenous tomano or iyo (Calophyllum inophyllum) is recommended as the dominant tree species. This is to be propagated in a nursery capable of producing 4 crops/year of 17,500 tree seedlings/crop at a cost of $4.00 each. The total cost of reforestation (trees and planting) is about $6,300/ha. Where only grasses and shrubs are planted, this is reduced to $400/ha.

Housing

234 ha have been allocated for housing in the land use plan with house block sizes of 1,000 m2. Larger areas of 1 ha are available for housing in the proposed agroforestry areas. This will meet projected housing demands for the next 80 to 100 years. A current backlog of demand for 400 houses plus an annual increment of 40-50 houses would require up to 1,400 houses to be constructed over the next 20 years but affordability may constrain actual construction, with a 3 bedroom house costing around $40,000.

The Government policies on housing construction need to be clarified, but it is recommended that a "user pays" principle be adopted with a private sector construction industry encouraged, with Government providing an advisory, quality control function to both home buyers and builders.

Nauru Rehabilitation Authority

A separate Nauru Rehabilitation Authority (NRA) is seen as necessary to bring together 10 professionals to work as a project team, for the term of rehabilitation, with links to all

existing institutions (Public Service, NPC, NIC and the private sector). This team should be led by an Executive Manager with equivalent Departmental Secretary status and somewhat greater powers to enable utilisation of resources across organisations.

Schedules and Costs

It will take an estimated 23 years and $230 million to complete the rehabilitation work. This does not include house construction which would cost an additional $56 million if 1,400 homes were built. Heaviest funding is required over the first 10 years ranging from $14-19 million/year, with a budget of around $8.5 million/year over subsequent years (no discounting is used in these figures).

Human Resource Requirements

The rehabilitation program will require a team of 10 contracted professional and about 140 technical staff who could be sourced from within the Public Service, NPC and NIC. It is recommended that young Nauruans be selected to undertake degree training in each of the following professions - civil engineering, architecture, town planning, forestry, landscape architecture, surveying and waste management).

New technical skills will be required in horticulture and waste management and young Nauruans should be selected for diploma and certificate training in these disciplines.

Social Impacts

The transition to a Nauru without mining needs careful planning. If Nauru is to become totally Nauruan after mining the social gaps left by foreigners (31% of the current population) need to be identified and measures taken to fill the voids.

Residual mining is likely to raise hopes of the landowners who will receive additional income. Housing plans will raise expectations of houses being built by Government. Both situations are not factored in to the rehabilitation plan. Market prices will not allow royalty payments for residual ore. Housing will depend on Government policy, but the enormity of the cost may dictate user-pays principles with minimum subsidies at best. This may lead landowners to reject participation in the rehabilitation program. It would appear to be a take it or leave it situation. If landowners opt out, the land would be left as unusable pinnacle land, destroying the dream of a rehabilitated Nauru.

Environmental Impacts

Special attention has been paid to the hunting of noddy birds. To avoid overexploitation the 3 month ban on hunting must be enforced and should be extended by 1-2 months. Limits on numbers of noddy hunting platforms is recommended together with a system of registration.

If residual and secondary mining and phosphate processing proceeds a full EIA is required.

Other Considerations

Following on from the general issue of land tenure reform, the question arises as to what will happen to topside land when mining ceases, and the land is rehabilitated in accordance with the Lands Act and the recommendations of the NACRDFS? The fragmented land ownership situation may stand in the way of deciding how the process should proceed. Whose land will be rehabilitated first, and whose last? Many other similar questions will be asked, and the landowners will demand some answers. A sensible way to provide these answers surely lies in the preparation of a strategic land use plan that seeks to develop rehabilitated land for the most urgently needed purposes, according to sustainable principles. Thus, under institutional strengthening land tenure reform is listed as a priority activity.

The NACRDFS has in fact provided a comprehensive starting point in the physical planning for the future sustainable development of Nauru. Some of the central ideas expressed in the NACRDFS may be used as a blueprint for not only Topside after mining has been completed, but Nauru as a nation. The Nauru Rehabilitation Authority (NRA), when established, should have an integral environmental protection or management role to go hand in hand with its Development Charter. This environmental responsibility should be overseen by the NECC so that all the relevant stakeholders have meaningful input, and so the activities of the NRA complement, rather than conflict with or duplicate, the activities of NECC and other entities involved in promotion of environmentally sustainable development in Nauru.

The NACRDFS study showed that rehabilitation IS feasible, and could be achieved at very little nett cost if residual mining proves to be economical. One unknown factor in the equation at this stage is the possible impact of secondary mining, both on the economic health of Nauru, and on the rehabilitation process itself. Should secondary mining prove economical and be carried out, this may delay the rehabilitation process and may change the face of the land significantly, depending on the depth and extent of the resource. Should this be the case, an Environmental Impact Assessment should be carried out to ensure that predicted impacts are minimized, and that all possible steps are taken to mitigate any adverse effects.

One way of resolving the land tenure difficulty is by resumption of land temporarily for the necessary physical processes to occur, and then return of the land to the owners (either in the same ratio of ownership as previously, or as individual parcels to individual owners), once rehabilitation is complete. In the latter case, individuals could be guaranteed a parcel of land for residential purposes, for their exclusive use, and could also share in any profits gained from secondary mining. This resolution of the land tenure situation would allow for an orderly program of rehabilitation of land, and for a land-use Plan to ensure the successful (both economically and ecologically) development of topside for the future. It may also serve as a model for public-interest resumptions of land on bottomside.

PROGRAM 1.2 REHABILITATION TRIAL

Agencies Responsible: Nauru Rehabilitation Authority (NRA), Ministry of Island Development and Industry (IDI), and the Nauru Phosphate Corporation (NPC)

Potential Funding Sources: Nauru-Australian Cooperative Agreement Fund, Nauru Rehabilitation Fund, and NPC.

Potential Sources of Expertise: NRA, NPC, AusAID and SOPAC.

Nature of Program: Another NACRDFS recommendation relevant to the NEAP is the conduct of a rehabilitation trial to test the practicability of the process of rehabilitation. If rehabilitation is seen as Nauru's most urgent environmental problem, it follows that no time should be lost in mounting a pilot rehabilitation effort. It is therefore within the scope of this report to recommend that the selection of a NACRDFS trial rehabilitation site be made by IDI, the NECC, or by the NRA, when it is established, as a matter of urgency, and that the planning and design of this activity become one of the first stages of the rehabilitation process.

Early selection, design and implementation of a trial rehabilitation site will:

1. Test the NACRDFS recommendations for physical reinstatement of the topography and soil profile.

2. Test the feasibility of residual mining efficiency.

3. Test the horticultural suitability of the soil profile.

4. Test the feasibility of producing land for housing on topside.

5. Provide an enormous amount of practical experience for Nauruans of what may be a twenty year or longer program of public and private works, leading to the future sustainable development of Nauru.

PROGRAM 1.3 SOIL MANUFACTURE

Agencies Responsible: Nauru Rehabilitation Authority (NRA), the Nauru Phosphate Corporation (NPC), MWCS, and the Nauru Island Council (NIC). Individual household could also be encouraged to make soil or compost on a small scale.

Potential Funding Sources: Nauru-Australian Cooperative Agreement Fund, Government Finances, NPC earnings, NIC budget and other appropriate sources or agencies.

Potential Sources of Expertise: NRA, NPC, NIC, AusAID, USP and PRAP.

Nature of Program: One of the recommendations of the NACRDFS was that a program of soil retention and manufacture be implemented in conjunction with any further mining activity. As stressed above, there is not enough soil currently stockpiled to revegetate or rehabilitate all the mined land. It is therefore recommended here that the manufacture of soil is an activity that can be immediately implemented by NPC and integrated into its regular mining process.

This activity is linked to that of green waste recycling (Program 7.4) outlined below. All vegetation removed from land prior to mining should be chipped or mulched for storage and re-use after composting as part of the soil manufacturing activity. This needs to be carried out in an area where material can be stockpiled and mixed through the composting process. The technology is widely available, although the economics of the process need to be studied and compared with the cost of importing fill material. The environmental cost of the latter option is regarded as too great to seriously contemplate.

PROGRAM 1.4 EROSION ASSESSMENT AND CONTROL

Agencies Responsible: IDI, NECC, MWCS, and NIC.

Potential Funding Sources: Nauru-Australian Cooperative Agreement Fund, Government Finances, NIC budget, SPREP, SOPAC and other appropriate sources.

Potential Sources of Expertise: NPC, MWCS, NIC, AusAID, SPREP, USP and SOPAC.

Nature of Program: Systematic surveys of sites of existing and potential accelerated coastal and inland soil erosion should be made. Once the extent and nature of the problem is documented, appropriate solutions can be developed and translated into policy. The soils of Nauru that do remain in undisturbed sites are generally of quite high fertility, although their agricultural potential is limited by a low moisture-holding capacity, and possible nutrient availability problems due to high alkalinity. Soils in Nauru are like those of all small islands in the Pacific - a very precious resource - whose conservation is of the utmost importance. The control of both coastal and inland soil erosion is thus seen as a priority.

In the case of coastal erosion, building set-backs from the spring high tide-affected areas may be imposed, and restrictions placed on types of development allowable within a specified distance of the coast. Coastal engineering best practices to minimize environmental impact could be included in all proposals for boat channels and other coastal works. Examples of this type of practice are given in the SOPAC Miscellaneous Report 177 "Coastal Protection in the Pacific Islands: Current Trends and Future Prospects" (1994).

Localised erosion and associated siltation occurs where sloping land has been left without sufficient vegetative cover. The area surrounding Buada Lagoon and areas adjacent to dirt roads on the escarpment are susceptible in this regard, and should be protected from siltation by physical means such as earth bunds and silt traps installed below any relevant soil-disturbing activity, and through appropriate programs of revegetation or roadside planting.

Concentration of stormwater should be avoided, and sheet flow encouraged to minimize erosion. If stormwater run-off must be disposed of into the ocean, the pipe carrying the water should be taken across the beach underground and a discharge point located on a solid part of the reef platform where erosion will be minimised. Care should be taken to position the pipe on a dead part of the reef, and a number of smaller outlets would be preferable to a single large one, to spread the impact more evenly.

Collection of stormwater for subsequent re-use (for example on public and private gardens) would be preferable environmentally, and would contribute efficiently and effectively to water conservation. The existing underground tanks next to the Civic Centre should be repaired, in this regard, and brought into use for a similar reason. This water is free of charge, and only needs to be collected! This is also discussed under Program 11.5 in terms of infrastructural development.

OBJECTIVE 2: STRENGTHENING OF ENVIRONMENTAL EDUCATION

Education and Environmental Awareness have often been seen as the cornerstones of an effective National Environment Management Strategy (Maiava and BNRD 1994). It is believed that any gains achieved in environmental management are sure to be lost unless they have the support and understanding of the majority of people. This feeling is well understood in Nauru, where the most important environmental issues are seen as those that related to the loss of traditional awareness of the natural environment as a life support system. There is also serious concern for the weakness of formal environmental and science education in the school systems and the lack of trained graduates in these areas.

It is thus seen as absolutely fundamental to the implementation of the NEMS that awareness raising programs be designed for students, women's groups, landowners, government employees, the private sector, and politicians and decision makers - to all the stakeholders in Nauru's sustainable future. Government employees will have the job of formulating and implementing environmental initiatives. Women will be very involved in helping to shape the attitudes of their families, and constitute an important voice in the society. Landowners must be able to understand the options and possible implication of future land use choices and how these will affect the future of Nauru. Politicians and decision makers must have the information and understanding required to make informed decisions in relation to land and resource use and environmental management. And, of course, children will be the leaders and decision makers of the future and the recipients of a sustainable or unsustainable Nauru. All have a role to play, a stake in Nauru's future, and are entitled to be actively involved.

This means that a very wide range of programs or activities is required, and these are shown in Table 5.1 and discussed below.

Table 5.1. Components that are considered essential to the development of an education and training strategy as a basis for the promotion of environmentally sustainable development in Nauru.

FORMAL EDUCATION

* Review of Environmental Education in the Nauru school system
* Curriculum development for Primary and Secondary School
* In-service training for Teachers
* Award of scholarships for Tertiary study

INFORMAL EDUCATION

* Awareness workshops for general public
* Production of fact sheets, resource materials and visual aids
* Application of traditional knowledge and management systems

INSTITUTIONAL STRENGTHENING

* Establishment of a focal point or repository for environmental education materials
* Strengthening of training for government employees

INFORMATION STRENGTHENING

* Baseline studies and recording of traditional knowledge
* Marine resource stock assessment
* Computerised data storage and retrieval

As can be seen from Table 5.1, there are at least twelve component initiatives that can be taken to strengthen environmental education in Nauru. Because the needs are so diverse, it may be well to actually begin with a "Master Program" that plans and prioritises the implementation of each individual initiative or activity. A benefit of this would be that scarce resources would be put to best use, and the materials that are produced or activities that are carried out in one area could serve as a basis, or resources, for other activities. This would provide efficiencies and could possibly lead to the combination of some activities. Such a "Master Program" could be called the Master Environmental Education Plan (MEEP).

There is also a need for some information gathering to reinforce the initial environmental education and awareness raising activities and to strengthen the scientific information database in areas where it is known to be lacking. This includes a need for up-to-date information on the state of the fringing coral reef and inshore fishery.

The proposals for the development of a MEEP and other associated environmental educational and information gathering activities are discussed in more detail under Programs 2.1 to 2.8 below.

PROGRAM 2.1 DEVELOPMENT OF A MASTER ENVIRONMENTAL EDUCATION PLAN (MEEP) AND THE ESTABLISHMENT OF AN ENVIRONMENTAL EDUCATION SUB-COMMITTEE (EES) AND AN ENVIRONMENTAL RESOURCE CENTRE (ERC)

Agencies Responsible: Ministry of Education, IDI, Nauru Island Council (NIC), USP Centre and NGOs.

Potential Funding Sources: Government Finances, NPC, NIC budget, SPREP, local private enterprises.

Potential Sources of Expertise: Older knowledgeable members of the community, SPREP, SPACHEE, USP, SPC, Greenpeace and PSDNP.

Nature of Program: The objective of this activity would be to provide a mechanism to coordinate the range of educational development or training programs proposed by the NEMS. An Environmental Educational Sub-committee (EES) of the NECC would be established, chaired by a Science Curriculum Officer or Senior Science Teacher. Administrative assistance would be provided by the Ministry of Education or IDI. Membership of the EES could include representatives from the Nauru Language Unit, the Secondary Schools of Nauru, the Curriculum Development Unit, the Nauru Island Council Environmental Education Officer, the USP Nauru Extension Centre and appropriate NGOs. As a part of the MEEP, an Environmental Resource Centre (ERC) should be established to collect, assess, catalogue, house and distribute relevant environmental information and curriculum materials. These materials would be made available to users through a loan system. The Nauru National Library could even be resurrected in this regard. The ERC would need photocopying and desktop computer publishing capability.

With respect to curriculum material, there is a great need for Nauruan-oriented materials to be produced in the form of fact sheets, marine and terrestrial plant and animals names, posters, leaflets, audiovisuals, newsletters and radio programs. In terms of textbooks and other resources materials, leaflets, case studies, and other environmental materials are available through the Nauru Extension Centre of the University of the South Pacific, SPREP Headquarters in Apia, SPC, Noumea and Suva, the Pacific Sustainable Development Networking Programme (PSDNP), Greenpeace, Suva and a range of other agencies that are relevant to the Pacific Islands and Nauru situations and that would be appropriate for Nauruan students. More general materials are available from Australia, New Zealand, Hawai'i and elsewhere. Such materials could be adapted for the Nauruan situation, or resource materials on Nauru could be developed to provide local examples or content related to a given topic in an existing textbook, environmental case study, etc. The function of obtaining multiple copies so that each class or each student can have their own, for example, with spares available when needed, could be a function of the Environmental Resource Centre, in cooperation with the Education Department and possibly the USP Extension Centre in Nauru. which would need a copying facility.

The Environmental Education Sub-committee (EES) would be charged with reviewing all proposed formal and non-formal environmental education programs, identifying target groups and priorities, and making recommendations on funding, resource needs, staffing, timing of delivery, and any other administrative matters. With their overview position, the EES will

have the ability to reduce duplication of effort, and gain the maximum synergies from the overall programs. One of its key roles could also be the identification of areas within the current curriculum where environmental materials on Nauru could be developed and introduced (e.g., into the Social Science, Biology, Chemistry, Health, English, Nauruan Studies programs).

Once the MEEP is established, it will be important to select one or two pilot programs, to be implemented as quickly as possible. These could be aimed at awareness-raising activities, and could double as publicity-generating for the master program itself. Preferably, one of these should be a public-based activity such as a " Keep Nauru a Pleasant Island Competition", and the other aimed at the Government sector, such as an increased emphasis on environmental issues in the media.

PROGRAM 2.2 TRADITIONAL ENVIRONMENTAL AWARENESS CAMPAIGN

Agencies Responsible: Ministry of Education, Ministry of Health, IDI Language Unit and Culture and Tourism Section, Nauru Island Council (NIC), National Radio and TV stations, Schools, USP Centre, Churches and NGOs.

Potential Funding Sources: Government Finances, NIC budget, USP Centre, SPREP, local private enterprises.

Potential Sources of Expertise: Older knowledgeable members of the community, SPREP, SPACHEE, USP, overseas media agencies.

Nature of Program: Traditional knowledge of Nauru's environment should be collected and recorded as a matter of urgency. In particular, fishing knowledge and noddy bird hunting and frigate bird capture and husbandry customs would be useful in establishing sustainable management plans of these resources. This is seen as of the highest priority because if such information is not gathered now, a central part of the Nauruan culture will be lost forever.

People who have special knowledge about plant and animals, ethnobiology (the study of uses, knowledge, beliefs and language for plants and animals and the environment), traditional fishing methods and customs, craft and flower garland manufacture, pandanus planting and traditional agriculture, weaving and canoe-making, etc., could be designated as "Nauruan National Treasures" and encouraged to participate in the development of curriculum materials for Science and Nauruan studies.

This project could be an on-going one that would not need to be costly, but which could quickly produce written materials of a basic nature, that could be up-dated on computer on a regular basis. Most Nauruan plant names and uses have been recorded, and these could form the basis of a simple, cost-effective publication. The similar recording of other nature-based words and names of important places and especially marine and meteorological terms would comprise the next step in the information-recording process. Any information collected, including taped verbal histories, should be deposited in the Environmental Resource Centre and other appropriate places, such as the USP Extension Centre Library.

PROGRAM 2.3 "KEEP NAURU A PLEASANT ISLAND" COMPETITION

Agencies Responsible: Ministry of Education, Ministry of Health, MWCS, IDI, NPC, Nauru Island Council (NIC), Nauru Chamber of Commerce, National Radio and TV stations, Schools, USP Centre, Churches and NGOs.

Potential Funding Sources: Government Finances, NPC, NIC budget, SPREP, local private enterprises, and Australian National and State Keep Australia Beautiful Councils.

Potential Sources of Expertise: SPREP, SPACHEE, USP, and Australian National and State Keep Australia Beautiful Councils.

Nature of Program: Competitions are very popular in Nauru. National competitions for frigate bird catching, the best flower garden and the loudest stereo are extremely successful annual affairs. Similar "Keep Australia Beautiful" initiative have been mounted at the National and State levels in Australia, and Fiji is currently trying to establish a similar program with the assistance of an Australian consultant.

A national "Keep Nauru a Pleasant Island" is proposed to commence in 1996 or 1997 (Pleasant Island was the name given to the island in 1798 because of its attractive appearance by the first known European discoverer of the island, Captain John Fearn of the British ship Hunter). The competition could be timed to coincide with "World Environment Day" each June, be organized by the EES, with National and Local Government Sponsorship through the Nauru Island Council. The competition would be aimed at the household level, and criteria for judging could be based on "Ten Environmental Commandments" (see Table 5.2 below for possible "commandments"). Winners would be declared in each District, and a National Winner chosen from these. Guidelines would be issued up to several months before the judging, to help people with their entries. Prizes could be awarded for the whole family, ranging from educational toys for children, to free services (such as a year's free solid waste removal) for the adults. Additional sponsorship could be sought from the Private sector, especially from businesses keen to market their environmentally-friendly products.

Table 5.2. "Ten Environmental Commandments" that could serve as criteria for the judging of a "Keep Nauru a Pleasant Island" competition.

1 WE SHALL NOT LITTER
(this could include ensuring that paper and waste, particularly glass bottles, tin cans and other items that are unsightly, dangerous or that serve as mosquito and insect breeding sites and habitats are cleared and disposed of properly, reused or recycled)

2 WE SHALL KEEP OUR HOME NEAT AND CLEAN
(This could include control of dust and dirt, regular maintenance and painting, control of rats, elimination of mosquito breeding sites, etc.)

3 WE SHALL HAVE REGULAR PHYSICAL EXERCISE

(This can include playing physically active sports, taking runs or walks in the early morning or after work, walks along the beach or on Topside, going to the gymnasium or doing aerobics. You can also do simple exercises at home. All of these activities can make people and the environment healthier)

4 WE SHALL HAVE A BEAUTIFUL AND USEFUL GARDEN
(This could include the planting of food trees and plants, other useful native Nauruan plants and fragrant and flowering plants, and the control of noxious weeds)

5 WE SHALL HAVE A FAMILY FOOD GARDEN
(This could entail the production of crops without pesticides and the planting of perennials and traditional tree crops that don't require large amounts of imported fertilisers or which can be grown using locally available animal manure, mulching, etc.)

6 WE SHALL HAVE A CLEAN AND EFFICIENT WATER SUPPLY SYSTEM
(this could include maintenance of clean water storage tanks, the presence of an effective rainwater catchment systems, maintenance of leaky faucets, the use of waste water for gardens and other appropriate water conservation measures)

7 WE SHALL CONSUME HEALTHY PRODUCTS
(This could include eating healthy food, drinking healthy beverages and not smoking tobacco)

8 WE SHALL KEEP HEALTHY ANIMALS
(this could include the raising of chickens or pigs in a hygienic way, as chickens serve a useful function of controlling unwanted insects and other pests, and looking after your dogs and cats and other animals so that they do not become pests, e.g., bark all night)

9 WE SHALL USE ENVIRONMENTALLY FRIENDLY PRODUCTS
(This could include not using styrofoam cups, plates and other products that produce CFCs, using aluminium cans instead of bottles that can break and be dangerous, the purchase of CFC-free refrigerators)

10 WE SHALL REDUCE, RECYCLE OR REUSE OUR WASTE
(This could include taking baskets to shop, recycling your aluminium cans, donating bottles to the hospital, composting your plant wastes, using your waste water for your garden, etc.)

PROGRAM 2.4 "ENVIRO-MEDIA" CAMPAIGN

Agencies Responsible: Ministry of Education, Ministry of Health, IDI, NPC, Nauru Island Council (NIC), National Radio and TV stations, Schools, USP Centre, Churches and NGOs.

Potential Funding Sources: Government Finances, NPC, NIC budget, SPREP, local private enterprises.

Potential Sources of Expertise: SPREP, SPACHEE, USP, overseas media agencies.

Nature of Program: As the media in Nauru are Government owned, there could easily be a coordinated campaign to lift the profile of the Environment on Nauru television and radio and in the print media, both editorially and in terms of content material.

There are many excellent environmental documentaries available for use on television internationally (e.g., programs produced/narrated by David Bellamy, David Suzuki, Richard Attenborough, etc.). There are also a wide range of environmental videos or movies available from SPREP, USP, TV New Zealand, Greenpeace and other agencies which can be shown on TV. These could be presented by a Government representative, explaining how the particular message of the documentary was relevant to Nauru. Issues of pollution, nature conservation, and sustainable development could be used to reinforce these concepts in people's minds and to reawaken their interest in both the natural environment and conservation issues.

Radio segments could also be written and presented to introduce people to different aspects of Nauru's environment and to highlight environmental problems and activities that should be encouraged to address these problems. These could draw on the facts and figures given in the NACRDFS reports, the issues highlighted in the NEMS, or provide information about the nauru environment from a wide range of other published materials. The programs could be moderated by a local personality or summarised in Nauruan so that people can better comprehend their significance. It may also be possible to have a weekly radio program along the lines of "Our Island Environment: A Foundation for Survival", which conducts interviews with persons on issues related to sustainable development on Fiji's National Broadcasting System.

The Weekly Newspaper is very widely read, and provides an excellent opportunity to communicate environmental ideas and issues to its readers. Again, a weekly "Our Island Environment" column would be appropriate. Simple competitions or quizzes could be published, with appropriate prizes offered for correct entries. Perhaps even a "talk-back" type program could be started, to assist with identifying any further issues about which people are concerned. This would certainly assist the consultation and consensus-building process.

These are only some of the many ways that the "Enviro-media" could be used to raise the profile of environmental issues and to enhance environmental awareness. Once the initial awareness programs are "up and running", the feedback obtained could be used to identify other areas to pursue in greater detail. For example, a survey could be undertaken to establish the extent of traditional environmental knowledge and/or to gather environmental knowledge, which could then be incorporated into educational material for schools and further environmental awareness campaigns.

PROGRAM 2.5 PILOT "OPERATION CLEAN-UP NAURU"

Agencies Responsible: NECC, Nauru Island Council (NIC), NPC, Nauru Chamber of Commerce, Ministry of Justice, National Radio and TV stations.

Potential Funding Sources: Government Finances, SPREP, Australian National and State Keep Australia Beautiful Councils.

Potential Sources of Expertise: Australian National and State Keep Australia Beautiful Councils.

Nature of Program: As stressed in Program 4.2 below most existing environmental legislation is either not well understood or not enforced. An example is the Litter Prohibition Act which is often ignored by both young and old citizens, with apparent immunity from prosecution. It is suggested that a "pilot" "Operation Clean-Up Nauru" be designed that takes the form of a National Campaign against litter, using a multi-pronged, multi-media approach. Such a program would be seen as complementing, rather than duplicating the "Keep Nauru a Pleasant Island" Competition.

This program should simultaneously address the many factors that may be identified as contributing to the problem, such as:

1. A lack of understanding about non-biodegradable solid wastes, and the expectation that waste will somehow "disappear" on it's own (it's often covered up conveniently by vegetative growth).

2. A confusing (and confused) official waste disposal system, that collects waste only if a household buys a regulation bin, and does not place bins at public places where littering often occurs, so making it difficult to dispose of litter in an acceptable manner.

3. An alcohol-consumption habit in outdoor places, that places the perpetrator in a frame of mind that doesn't promote civic responsibility.

4. An increasing obliviousness to something that always seems to have been there (i.e., litter), and that grows in an imperceptible way, so that no great change (i.e., in the amount or appearance of the litter) seems to have occurred over time, and the 'problem' seems not to exist or is not recognized.

5. A reluctance by the Police to enforce a law that is obviously being broken but the only penalty for which is a $300 fine, something that seems to be out of scale with the seriousness of the offence.

There is no one solution to this set of factors. Rather, the objective of changing people's attitudes and behavior may be addressed by an integrated, multi-faceted campaign approach, that addresses all of the above reasons. The components of the campaign could include, for example:

1. A public awareness campaign that explains the dangers of non-biodegradable waste to the environment, and the benefits of recycling such items as aluminium cans. Offering a small sum of money per can for collection by school children (to be recovered after shipping back to the manufacturer) could be successful. A deposit could also be charged on each new can when sold, recoverable after its return to a recycling depot or store (see Programs 7.1-7.4 below).

2. A coordinated solid waste disposal system for Nauru that retrieves waste from every household on a weekly basis, and that places bins for regular collection at regular points around the coastline and other popular spots, such as sports facilities, major commercial centres, etc. Separation of waste and management of the dump are discussed in more detail below in Programs 7.1-7.4.

3. Education about the effects on health of binge drinking and the anti-social nature of this kind of behavior in public places.

4. A focus during "Keep Nauru Beautiful" or "Clean-Up the World" days on creating areas that are declared "litter-free zones", so that people can see the benefits of this kind of environment, compared with one where litter continues to accumulate.

5. Implement an "Adopt a Part of Nauru" program where a given school, government department, business, family, church, NGO, sports team or club, or community adopts a section of road or beach or a part of Nauru for which it would then become responsible for keeping litter-free. This has been very successful in parts of the United States and Australia where "Adopt a Highway" and "Adopt a Beach" programs have been successful in eliminating litter from highways and beaches.

6. A review of penalties away from monetary fines, to ones where convicted people are required to carry out so many hours of community service, particularly the cleaning up of litter in "litter-free" zones!

This kind of integrated approach can best be planned and implemented by a body such as the NECC, with the cooperation of relevant agencies. The combined effectiveness of each of these activities will be much greater than each one individually, and should serve to focus the community's attention on the issue.

It is not by chance that the example of litter has been used in this report as a model for ways in which the integrated approach can be used to maximum effect in environmental management. Firstly, experience in other countries such as Australia and the United States has demonstrated success in controlling the litter problem (which is part of the larger solid waste problem) through such integrated programs that have succeeded in changing people's attitudes and behavior, over time.

Secondly, people's attitude to litter and waste is in many ways a barometer of their general attitude to the environment, and the way in which they perceive their responsibility to its

preservation. By changing people's attitudes to litter and waste disposal in a pilot program, it might be possible to awaken their interest and awareness about other, equally important environmental issues.

The success of such an integrated campaign, if monitored on a regular basis, could be extended to other spheres of environmental management, and used as a model which can be constantly upgraded and reviewed depending on it's success or otherwise. Other areas of legislation such as the Public Health Ordinance and the Animals Act could then be focussed on by the NECC with a view to lifting public awareness of the issues in the "softer", non-controversial areas that are clearly in the Public interest as a whole, before tackling those issues where some opposition could be expected from narrow interest-groups. Thus, skills and experience are gained and accumulated by the NECC in "winnable" situations.

PROGRAM 2.6 UPGRADING SCIENCE EDUCATION

Agencies Responsible: Ministry of Education, Nauru Island Council (NIC), National Radio and TV stations, Schools, USP Centre, USP.

Potential Funding Sources: Government Finances, AusAID, New Zealand Aid.

Potential Sources of Expertise: Older knowledgeable members of the community, USP, educational institutions in Australia and New Zealand.

Nature of Program: The teaching of Science in Nauru, and Environmental Science in particular, would be effectively strengthened by the establishment of a Science Laboratory. This facility could be used both for Secondary students and for the teaching of USP Extension courses in science, and is regarded as essential for obtaining practical experience in this discipline. The Laboratory would provide a focus for both physical and biological science learning, as well as an introduction to technology.

At the same time, equally high priority needs to be given to the training of Science teachers at all levels. A minimum requirement would be one science specialist secondary teacher with a biological science qualification at the degree level. In-service courses could easily be organised within the Laboratory situation. This would provide an incentive for Nauruans to enrol in extension courses at USP that are presently denied to them because of the lack of laboratory facilities. The more teachers who are better qualified in science, the more that can be achieved in terms of writing and implementing curriculum material which is appropriate for the Nauru environment.

PROGRAM 2.7 TERTIARY TRAINING IN ENVIRONMENTAL SCIENCE AND ENVIRONMENTAL MANAGEMENT

Agencies Responsible: Ministry of Education, IDI, USP Centre, USP, SPREP, overseas tertiary technical and academic institutions.

Potential Funding Sources: Government Finances, AusAID, New Zealand Aid, SPREP.

Potential Sources of Expertise: SPREP, SPC, FFA, SOPAC, USP, educational institutions in Australia, New Zealand, the United States and elsewhere.

Nature of Program: Nauru has few formally qualified environmental scientists, engineers, and economists. This needs to be redressed by encouraging young Nauruan men and women who are interested in enrolling in many of the appropriate courses offered at the University of the South Pacific and elsewhere. A dedicated scholarship may be provided for study in the Environmental Sciences, possibly tied to a subsequent period of Cadetship with the Public Service.

At the Government level, education and training programs would be concentrated within the Ministries of Education and IDI. The former is currently constrained by a weakness in Science and Environmental personnel and facilities, and a number of specific programs are suggested to redress this problem. The latter has recently appointed an Environment Officer, whose training will need to be upgraded on a continuing basis.

Additionally, there is great scope for the conduct of short- and medium-term in-service courses or workshops as a means of improving environmental awareness. Many are available, both within the region and overseas. SPREP, in particular, has an ongoing program of environmental training workshops, which are available to both government and NGO participants. There are also many opportunities for funding locally-based environmental education workshops. There is no doubt that, the more that people know about the environment, the more they would like to learn, and it is believed that the thirst for knowledge will be a self-sustaining one, much like the process of development should be.

A great deal will be achieved when such programs are implemented. Teachers and Government Officers will be better trained, NGOs will have strengthened their environmental capacities, general public awareness of the issues will be raised, and the education system will be better equipped for environmental education.

OBJECTIVE 3: STRENGTHENING ENVIRONMENTAL INSTITUTIONS AND LEGISLATION

As stressed in Chapter 4, a major pre-condition for the successful implementation of the NEMS and the NEAP is the strengthening of environmental institutions and legislation in Nauru. This would include the following "Programs": 1) establishment of a Nauru Environmental Coordinating Committee, 2) adoption of the environmental impact assessment process, 3) development of a land use planning system, 4) land tenure reform,
5) conduct of relevant environmental baseline studies, 6) establishment of a nauru environmental information system, 7) review and enforcement of existing legislation, and, 8) enactment of new environmental legislation.

PROGRAM 3.1 ESTABLISHMENT OF A NAURU ENVIRONMENTAL COORDINATING COMMITTEE (NECC)

(Alternative Title: **National Task Force on Environment Management and Sustainable Development**, a name similar to that selected by the Marshall Islands and a number of other countries that have designated such a group a "Task Force").

Agencies Responsible: IDI, NPC, NIC

Potential Funding Sources: Nauru-Australian Cooperative Agreement Fund, Government Finances, SPREP and UNDP.

Potential Sources of Expertise: SPREP, USP and appropriate overseas expertise.

Nature of Program: Although many Government agencies and NGO's are involved in worthwhile activities related to environmental management and the promotion of sustainable development, these activities are often carried out in isolation from one another. There is great potential for gaining strength and synergy by coordinating these individual efforts in a spirit of informed co-operation. **It is proposed that a National Environmental Coordinating Committee (NECC) or task force be established immediately to facilitate and coordinate the increasing integration of environmental concerns into the policy-making and development planning processes.** This is in line with the worldwide push to promote environmentally sustainable development, the central theme of both the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992 and the Conference on Sustainable Development for Independent Small Island states held in Barbados in 1994. This is also in support of the South Pacific Regional Environment Programme (SPREP) initiative to assist member countries to strengthen environmental capabilities and to development National Environmental Management Strategies (NEMS).

Responsibilities of the NECC: The responsibilities of the NECC would be as follows:

1. Review, edit and amend as appropriate the draft National Environmental Management Strategy (NEMS) for Nauru.

2. Recommend the final version of the Nauru NEMS to Cabinet for acceptance as policy for the Government of Nauru.

3. Coordinate the implementation of the NEMS by the relevant agencies according to the Policy and Priorities of the Government of Nauru.

4. Provide coordination and liaison between the agencies responsible for on-going environmental management and sustainable development in both the public and private sectors. This would include close liaison with the Nauru Rehabilitation Authority, when it is established.

These responsibilities could be modified or additional responsibilities added when considered appropriate.

NECC Committee Membership: The suggested membership of the NECC, subject to appropriate modifications or additions, is as follows:

1. One high-ranking representative from each of the following Government Agencies (from time to time other agencies may become members according to the relevance of particular issues).

   Ministry of Island Development and Industry
   Ministry of Education
   Ministry of Health and Medical Services
   Ministry of Works and Community Services
   Ministry of Justice
   Nauru Phosphate Corporation
   Nauru Island Council

2. One Representative from each of the Following Non-Government Organizations (NGOs)(from time to time other agencies may become members according to the relevance of their particular issues).

   Nauru Chamber of Commerce
   Nauru Environmental Association
   Women's Groups
   Nauru Cultural/Historical Group
   Nauru's main Churches/religious denominations

3. The President of Nauru, because of his role as Minister of IDI, and because of his central role in guiding all development in Nauru, will be a *de facto* member, and should attend the meetings when appropriate.

4. The Environment Officer from IDI will be a *de facto* member.

Secretariat: It is recommended that the Ministry of Island Development and Industry (IDI) serve as the secretariat for the Committee, with either the Environment Officer, or another appropriate person from IDI, acting as the Secretary, providing minutes and agendas and fulfilling other administrative secretarial duties.

Chair and Vice-chairs: It is recommended that the Committee Chair be elected by and from the Members, on a rotational basis, for a term of one calendar year. Vice-chairs may also be elected as the need arises, to be responsible for implementation, coordination and monitoring of a particular environmental activity, project or program. For example, a Vice-chair may be elected to make recommendations to the full Committee on a technical aspect of fisheries management, and may draw on the expertise of other Committee members, or people outside of the Committee.

Frequency of Meetings: It is recommended that the NECC meet on a monthly basis or as needed during the first year. Meetings may then be set on a longer interval basis, perhaps bi-monthly, with the provision for extraordinary meetings to be called on 24 hours' notice. Such extraordinary meetings could be called, for example, to discuss preparations for, or results of, important regional meetings, natural disaster management and rehabilitation, national competitions, launching of environmental educational materials, etc.

Attendance at Meetings: The effectiveness of the NECC will depend on the degree of communication and cooperation between members and organisations and the contribution that each makes during the regular meetings. Should a Member be on extended leave, it is his or her organisations's responsibility to nominate an alternative representative. If a member fails to attend more than two meetings in a row, the agency or organization that he or she represents should be notified by the Secretary and asked to provide an alternative representative.

Reports to the Committee: It is recommended that each Member supply a brief report to the Secretary no less than 48 hours before each scheduled meeting, to explain the progress that has been made on his or her organization's proposals, programs, projects or activities. This need only be in note or outline form, to minimize the need to read or write long documents. The Secretary will then distribute these reports as addenda to the minutes, to fully inform the Members. These reports could then be summarised for inclusion as items in the minutes of each meeting, which could then serve as a record or the progress of environmental activities in Nauru.

Reports from the Committee: It is recommended that the Committee have the ability to submit proposals or reports (whether annual or otherwise) to Ministers or Cabinet on any relevant Environmental issues, projects or programs, provided that the proposals or reports receive the consensus support of the NECC.

PROGRAM 3.2 ADOPTION OF THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

Agencies Responsible: NECC, IDI, MOJ, NPC, NRA and NIC

Potential Funding Sources: Nauru-Australian Cooperative Agreement Fund, Government Finances, SPREP and UNDP.

Potential Sources of Expertise: SPREP, USP and appropriate overseas expertise.

Nature of Program: The Environmental Impact Assessment (EIA) process is a means of:

1. predicting impacts that development projects or proposal might have on the natural and cultural environment;

2. identifying and recommending strategies to reduce, if not eliminate, negative impacts of projects; and,

3. identifying ways of monitoring projects in case unforseen problems arise.

It is strongly recommended that Nauru adopt the EIA process, develop an EIA capability, and that EIA become a requirement for to all future development projects. Given the current organisational structure in Nauru, the EIA responsibility and capability should be held by IDI, with appropriate involvement of other agencies such as the Ministry of Justice, the NECC and agencies such as NPC, NIC and NRA which will be involved with major developments or projects on the island.

Prior to the adoption of the EIA process (and this reflects the current situation in Nauru), cost-benefit analyses are based largely on economic and engineering (technical) feasibility studies. With the adoption of the EIA process, projects are also required to be assessed in terms of whether they are going to be safe for people and the environment, and whether they are environmentally and culturally sustainable. The EIA process usually includes an assessment of the social and economic consequences of a project as well as the non-human biological and physical environment. There is normally also an opportunity for public input into the process (e.g., public meetings to discuss the findings and recommendations arising out of an EIA study).

Emphasis in EIA is also placed on the accountability of project proposers/developers for serious, often unforseen impacts of projects. To minimise such risks, a risk analysis is usually required as part of the EIA for hazardous proposals. International issues such as global warming, ozone depletion and deforestation may also be included in the EIA, if cumulative effects are thought to be relevant, both locally and internationally.

The EIA process is usually carried out in a number of stages. Firstly, the proposal is examined by the overviewing agency with respect to its most likely overall impacts. This is called **"scoping"** the proposal, and usually results in the development of a set of Terms of Reference that need to be addressed during the following stages. The main aim is to ensure that potential problems or issues are identified and addressed in the early stages of project design and

feasibility planning. It is also a means of deciding whether a given project will need to be subjected to a comprehensive EIA. Some of the main issues addressed by the EIA are summarized in Table 5.3.

Table 5.3. Issues or questions addressed in the Environmental Impact Assessment (EIA) of potential or proposed development projects (Adapted from UNEP 1988).

* Can it operate safely, without serious risk of dangerous accidents or long term health effects?

* Can the local environment cope with the additional waste and pollution it will produce?

* Will its proposed location conflict with nearby land uses, or preclude later developments in the surrounding area?

* How will it affect local fisheries, farms or industries?

* Is there sufficient infrastructure, such as roads and sewers, to support it?

* How much water, energy and other resources will it consume, and are these in adequate supply?

* What human resources will it require or replace, and what social effects will it have on the community?

* What damage may it inadvertently cause to assets such as forests, tourism areas , or historical and cultural sites?

By way of example, it is useful to address two recent projects that have been initiated in Nauru. Firstly, the new softdrink factory in Aiwo will produce effluent with a high sugar content. How is this to be disposed of, and what impact might it have on the marine environment? Secondly, a new milkfish pond has recently been excavated on Bottomside in Ewa District directly into the water table. What effect will there be on water quality and will this constitute a health hazard to young children? Although the impacts of these two developments may turn out to be negligible, it is in the best interests of both Nauru and the landowners involved to subject such projects to the EIA process to identify and address any possible negative effects before they cause serious problems.

Next, **"prediction"** occurs as to what will be the extent of the changes caused by the project. It is important at this stage to concentrate on the main issues (see Table 5.3), and not get side-tracked by trying to look at too many issues in too much detail. Although the deletion of potential effects from consideration involves some risk, the EIA's findings must be readily accessible and immediately useful to the project planners and EIA officials.

Thirdly, an **"evaluation"** is made of how significant the predicted changes might be, and if so, how they can be **mitigated** (made less damaging) through **design changes** and sound environmental management. It is important here to involve appropriate people and groups to ensure a comprehensive approach is maintained, but again without wasting time and effort on irrelevant issues. Those who can contribute facts, ideas or concerns, those who are managing the EIA, decision makers, and groups who are likely to be most affected by a given development should all participate in the EIA process. To assist decision makers, the EIA must be designed so that it presents clear choices for the planning and implementation of the project, and should make very clear the likely results of each option.

The **"communication"** and **"documentation"** of the conclusions of the EIA is essential for the information of both the proposers of a given project and for the benefit of the relevant authorities or affected groups. The essential findings should be presented in a concise document, supported by separate background materials where necessary. The "hard" facts and predictions about impacts should be presented, with comments on the reliability of the information, including summaries of the consequences of each of the options. This results can also be presented orally to special meeting of policy makers or government or to open public or community meetings.

Finally, arrangements need to be made for the implementation or **"enforcement"** of imposed development conditions and **"monitoring"** programs that have been agreed upon. Questions such as how long must monitoring continue, and whether it be undertaken by the developer or by an appropriate regulatory authority, need to be considered.

PROGRAM 3.3. DEVELOPMENT OF A LAND USE PLANNING SYSTEM

Agencies Responsible: IDI, MWCS, MHMS, MOJ, NPC, NRA and NIC

Potential Funding Sources: Nauru-Australian Cooperative Agreement Fund, Government Finances and UNDP.

Potential Sources of Expertise: SPREP, USP and appropriate overseas expertise.

Nature of Program: The future environmental management of Nauru will depend on the ability to make rational land-use planning decisions. Such decisions can only be made in the context of a formal planning system, where Government controls the way in which different parcels of land can be used in different circumstances or for different purposes. Such purposes may be residential, retail, commercial, agricultural, industrial, storage facilities, waste disposal, Government facilities, conservation, or any other legitimate use. No land-use planning legislation currently exists. **It is recommended that a land use planning system be put in place to develop a rational plan for the sustainable development of Nauru** (see also Program 1.1).

The main objective of a planning system would be to coordinate development so that it occurs in a rational and sustainable manner. When conflicts occur, these can be resolved within the context of planning process. For example, some land-uses are not regarded as compatible (e.g. residential and industrial), and some land (e.g. very steep or unstable) is not suitable for building. These constraints need to be acknowledged, and reflected in the planning process and in a land use plan for Nauru. In addition, such a plan would provide for infrastructural needs such as transport and services corridors, water storage, cemeteries, churches, airports, areas for parks and recreation, nature conservation and other public uses.

The first stage in the planning process is to identify where the different required land uses might occur, such as in the plan proposed for topside by the NACRDFS study. This is called a strategic plan, or master plan, and can provide the basis for all further discussion and amendments. Strategic plans are usually reviewed every five to ten years, and no plan should be regarded as being "set in concrete".

The establishment of a planning framework for Nauru could be achieved through the initiation of a Land-use Planning and Development Act. This Act would establish some kind of Planning Authority whose charter would be to develop a master plan for future land use. It has already been suggested that this could be the role of the proposed Nauru Rehabilitation Authority for Topside, although its brief would not necessarily extend to Bottomside land. It is a matter for debate whether the Planning Authority should be able to cover the whole of Nauru, and if this is accepted, this function would fall outside of the NRA's charter. The latter would then be restricted to the physical rehabilitation process itself.

Such a Land Planning Act would need to be preceded by public consultation and an associated awareness campaign outlining the benefits of land-use planning. The concepts of spatial planning, land management, and planning controls are probably well understood in a

traditional sense, but need to be synthesized into relevant and reasonable legislation for the modern context.

PROGRAM 3.4 LAND TENURE REFORM

Agencies Responsible: Nauru Land Commission, Parliament, Ministry of Justice, IDI, NPC and NIC.

Potential Funding Sources: Government resources, SPREP, FFA, Forum Secretariat.

Potential Sources of Expertise: Nauruan elders and landowners, SPREP, USP Land Management and Law Programs and overseas environmental law experts.

Nature of Program: It may be necessary to examine the issue of land tenure at the same time as, if not even before, the establishment of a Land-use Planning and Development Act. This is because the complexity of existing land tenure arrangements probably constitutes the greatest single barrier to rational land use planning and rehabilitation in Nauru. **It is recommended that land reform, particularly in terms of the control of lands designated for public purposes or for the rehabilitation of the mined-out lands, be made a priority.**

Logic dictates that Government needs to have some control over land use through a planning system similar to that used in other urbanised societies. Although, wholesale or widespread resumption of land to public or Government ownership is not likely to be a popular policy in Nauru, the "common good" is a powerful argument for **some** resumption of land, with appropriate financial or other compensation for affected landowners. Landowners should not be disenfranchised from their land inheritance, but should be given the opportunity to participate in the rewards of an effective planning and land development/rehabilitation program. For example, they may be compensated for land resumed on Bottomside by being given rights to an equivalent area of improved Topside land after rehabilitation is complete.

If the existing land tenure system continues, one unavoidable consequence will be a continuing dilution of individual shares. This will come about as a consequence of population increase and the inheritance system, where there will be an accompanying increase in the number of individual owners of each parcel of land. The logical end result of this at some stage in the distant future will be that virtually every parcel of land will be owned simultaneously by every Nauruan! This is clearly no different from Public (i.e. all the people) ownership of the land, the irony of which is surely not lost on thinking Nauruan landowners!

It is here recommended that a forum be established, whether through the Land Commission or some other Government entity, to initiate discussion on the land tenure issue. It is considered vital that the discussion be community based, and that landowners have every opportunity to participate, and be fully aware of any ideas or options that are proposed. The discussions may be long and involved, but the objectives of rational land use planning should be clearly enunciated at the very beginning, and the advantages to future generations of Nauruans should be clearly seen.

The overall objective of the land reform could ultimately be the identification of lands targeted for rehabilitation by the NRA and other lands that are to be used for the "common good" (public good) of all Nauruans, so that they can either be resumed or put under appropriate Government control so that planning and development for environmentally sustainable

development and the rehabilitation of Nauru can proceed. As suggested above, this could take the form of long-term leases for the landholders or alternative compensation. The problems of land fragmentation must also be addressed in an appropriate manner if land reform is to be practicable.

PROGRAM 3.5 CONDUCT OF RELEVANT ENVIRONMENTAL BASELINE STUDIES

Agencies Responsible: IDI, NPC, NIC and NECC

Potential Funding Sources: Nauru-Australian Cooperative Agreement Fund, Government Finances and SPREP.

Potential Sources of Expertise: SPREP, USP, FFA, SPC, SOPAC, AUSAID and appropriate overseas agencies.

Nature of Program: In order to make informed decisions about sustainable development and to increase local content in environmental awareness campaigns and environmental education, there is a need for some baseline studies and more information on the state of Nauru's environment, especially the nearshore marine environment. **It is recommended that NECC, in consultation with MEES, establish a priority timetable for the conduct or commissioning of baseline studies or the compilation or information that they decide are necessary.** These may relate to anything ranging from the population ecology of a single species (e.g., of the black noddy, the Nauru canary or the milkfish), a study of shellfish resources, or the identification of desired archaeological preservation or conservation sites. Some studies will no doubt be related to specific programs proposed in this report.

Given the importance of the inshore fishery and fringing reef to environmentally sustainable development in Nauru, this area is particularly identified as one that is in urgent need of some baseline studies and monitoring. Other possible information needs could be an inventory of indigenous bird populations and habitats, information that could be very valuable in terms of conservation area designation and for environmental education curriculum development and field studies. Information on the location and populations of endangered indigenous plants could also be gathered. As suggested above, information on the location of areas where accelerated coastal erosion is taking place, areas of excessive waste disposal or mosquito-breeding sites, etc. would also be valuable.

PROGRAM 3.6 ESTABLISHMENT OF A NAURU ENVIRONMENTAL INFORMATION SYSTEM

Agencies Responsible: IDI, NRA, NPC

Potential Funding Sources: Nauru-Australian Cooperative Agreement Fund, Government Finances, SPREP and AusAID

Potential Sources of Expertise: SPREP, USP GIS Unit, and Australian GIS agencies.

Nature of Program: Once environmental information is available or collected it should be stored in a way so it is easily accessible to potential users. **It is recommended that a Nauru Environmental Information System or Data Base be established into which relevant data on the environment, environmental management and sustainable development can be stored.** This could take the form of a Geographic Information System (GIS) similar to that initiated for Nauru during the recent NACRDFS project, which produced maps of the locations of a wide range of important geographic information (e.g., land-use plans, soil, geological and vegetation maps, locations of endangered tree species, etc.). Although the GIS facility was designed for use by the Nauru Rehabilitation Authority, it would be of great benefit if the information and system were made available, or adapted to the needs of the NECC. In return, environmental information stored by the NECC would be available for input into the GIS and use by the NRA.

It is suggested that a computerized database system be established to record and retrieve environmental and resource based information. This system would become the main repository for land- and marine-based environmental information, and should be compatible with the MapInfo-based GIS referred to above. The system should be user-friendly and training provided for its use to relevant Government and NGOs.

Information from the environmental baseline surveys suggested above could be entered into the GIS and updated periodically. Printouts, in the form of maps or data lists, could be used for both planning purposes and in the production of curriculum materials or for environmental awareness campaigns. The possession of such a database would also easily allow the publication of a wide variety of reports (See also Program 2.1 above).

PROGRAM 3.7 REVIEW AND ENFORCEMENT OF EXISTING LEGISLATION

Agencies Responsible: Ministry of Justice, Ministry of Health, IDI, NPC and NIC.

Potential Funding Sources: Government resources, SPREP, FFA, Forum Secretariat.

Potential Sources of Expertise: Nauruan elders and landowners, SPREP, USP Law Department and Australian and other overseas environmental law experts.

Nature of Program: Because of the inadequacy, ignorance of, or non-enforcement of existing environmental legislation, it is recommended that it be reviewed in relation to environmental management and the promotion of sustainable development in Nauru. There is also a need for the regulations to be clarified and advertised through an awareness campaign by the authorities (see Program 2.5 above).

Drawing on the experience of Program 2.5, reviews of the administration and enforcement of the other environmentally-relevant legislation can be put in place. Sufficient resources will need to be allocated, including the services of lawyers who are familiar with Nauruan law and customs, or at least those of other Pacific Island Nations. The brief should attempt to outline the needs of the community in simple terms, in order to achieve the best outcomes.

PROGRAM 3.8 ENACTMENT OF NEW ENVIRONMENTAL LEGISLATION

Agencies Responsible: NECC, Ministry of Justice, Ministry of Health, IDI, NPC and NIC.

Potential Funding Sources: Government resources, SPREP, FFA, SOPAC and Forum Secretariat.

Potential Sources of Expertise: USP Law Department, Nauruan elders and landowners, SPREP, and Australian and other overseas environmental law experts.

Nature of Program: There is a need to enact some new legislation to address Nauru's more serious environmental issues and to promote sustainable development. It may also be necessary to bring relevant existing and new or modified legislation together into a single comprehensive body of environmental laws.

It is recommended that a review be carried out of areas where there is a need for new environmental legislation, and whether it is desirable to have a single body of environmental legislation. This program could be carried out as a single activity along with the review of existing legislation (Program 3.4 above).

For example, the Marine Resources Act is currently being reviewed for the purpose of instituting new Regulations. New legislation will also be required for the introduction of nature and biodiversity conservation measures. Proposed agricultural and horticultural industries will require Quarantine Regulations to be strengthened and strictly enforced to protect their future and to ensure that unwanted pests and weeds are not introduced into the country.

The identification of other areas where there is a need for new or strengthened legislation will occur during the review process, or be suggested by consensus. In each case, a decision will need to be made for referral to Government, who will assess the need in terms of their policies and legislative program.

Should Government agree to proceed to the drafting stage, appropriate legal assistance would again be needed, and resources allocated for this purpose. The same would apply if Nauru decides to develop comprehensive environmental legislation.

In terms of whether a comprehensive single body of environmental legislation is required in Nauru, perceived benefits would include simplicity in terms of implementation and enforcement, and in making the public aware of environmental issues in relation to the laws that are designed to address them. Drawbacks could include the perception of excessive Government interference in commerce and industry. Although other NEMS studies have recommended comprehensive environmental legislation (e.g., Palau and Kiribati), no information is yet available on the success or possible negative impact of such an approach.

It is recommended that the members of the NECC and the relevant ministries observe those places that have attempted to develop comprehensive environmental legislation, and see whether real gains have been achieved, or whether it has only created greater bureaucracy.

The more important question for Nauru may concern the most effective way to utilize the available resources to achieve the desired increase in environmental awareness across the whole national and social spectrum. It may be a better strategy, in the case of Nauru, to educate and legally empower a greater spread of people across more Government Departments and NGO's. This will have the effect of encouraging cooperation, coordination and responsibility, rather than increasing the centralisation of responsibility on a single agency.

OBJECTIVE 4: CONSERVATION OF BIODIVERSITY

Biodiversity (short for biological diversity) is defined as the diversity of different kinds of terrestrial, freshwater and marine ecosystems, the different individual plant and animal species found in these ecosystems, and the genetic diversity within these species (e.g., the range of traditional pandanus varieties that used to grow on Nauru). For societies that live closely to and depend for their survival on their natural environment, biodiversity would also include the diversity or richness of the knowledge, uses, beliefs and language that they have for their biodiversity.

Because of the importance of plants and animals, the conservation of biodiversity is seen as a fundamental requirement for the long-term promotion of environmentally and culturally sustainable development in Nauru. The identification of a system of conservation areas or sustainable development zones is seen as one of the most effective ways of reversing the processes of the loss of biodiversity and further land degradation, and of protecting endangered ecosystems and plant and animals species. There is also a need to identify species which are seriously endangered and which require immediate protection, and to adopt pest control and quarantine measures that protect local plant, animal and human populations from displacement by aggressive or noxious introduced pests, weeds and diseases.

Programs that are recommended to promote the conservation and protection of biodiversity include:

1. Survey and selection of priority conservation areas;
2. Establishment of pilot Conservation Areas under the SPBCP;
3. Protection and rehabilitation of endangered plants and animals;
4. Noddy bird population biology study and conservation initiative;
5. Forestry and Agroforestry Development Plan;
6. Establishment of a nursery system for endangered and culturally-important plants;
7. Establishment of a Rehabilitation Nursery; and,
8. Establishment of a Nauru National Botanical Garden and Arboretum.

These programs are discussed individually below.

PROGRAM 4.1 SURVEY AND SELECTION OF PRIORITY CONSERVATION AREAS

Agencies Responsible: IDI, Ministry of Justice, NIC and NECC

Potential Funding Sources: SPREP, Nauru-Australian Cooperative Agreement Fund and Government Finances.

Potential Sources of Expertise: SPREP, USP, FFA, SPC, SOPAC, AUSAID and other appropriate overseas agencies.

Nature of Program:

Although a number of potential conservation sites have been identified during the NACRDFS and the NEMS preparation visits, **it is recommended that a more comprehensive survey and checklist be established to ascertain how many possible sites exist, how many should be proposed, and what strategy should be followed to achieve a representative sample of both terrestrial and marine vegetation types and habitats.** The information gained from such surveys could be used as a basis for designing a management plan for each site, and to establish baseline data against which future observations could be compared. Consideration also needs to be given as to how the network of Conservation Areas will fit into the overall land-use plan for the future, so that Nauru is not disadvantaged from an economic point of view. Ecology and Economy must work together in this most critical planning process.

Criteria, adapted from SPBCP, that could be used for the selection of "priority conservation sites" are:

1. Sites should have a wide range of terrestrial and marine ecosystems and biodiversity that are representative of Nauru as a whole;

2. Sites should be those showing the least level of disturbance, highest species richness, the greatest numbers of rare or endangered species, and the most value as wildlife and marine habitats, with particular emphasis on those sites that are important noddy bird rookeries;

3. Sites should contain culturally important and useful plants, animals and ecosystems of particular cultural and economic value to the people of Nauru, such as coconut, breadfruit and *Pandanus* cultivars, mangroves, *Pisonia grandis* and other species that comprise the main noddy bird rookeries;

4. The sites and biodiversity could be threatened by overexploitation, degradation or conversion to non-sustainable uses;

5. The communities (resource users and owners) and their representatives must give a clear commitment to participatory involvement in the planning, implementation, monitoring and modification of the conservation initiative; and,

6. The location of the conservation areas could facilitate the initiative in terms of logistics, cost and time constraints and the desire for the benefits to be spread among all Nauruans.

Based on these criteria the sites within Nauru that have been tentatively identified for protection status as biodiversity conservation areas or areas of limited entry, and which should be considered for formal designation as conservation areas, include:

1. The entire Anibare Bay area from the Meneng-Anibare District boundary to the Anibare-Ijuw District boundary, and including the Meneng Hotel and extending to the edge of current mining activity (this would not preclude normal activities of current residents, but would protect escarpment and coastal vegetation and could include the fringing reef area which would be developed as a marine reserve in which spearfishing, net-fishing and reef gleaning would be prohibited within 100 m from the mean low tide. See Program 5.1 below).

2. The Ijuw-Anabar mangrove and wetland area because of its unique ecological importance and scenic beauty.

3. Buada Lagoon (a unique landlocked freshwater or slightly brackish central lagoon) and suitable portions of the remaining forest surrounding Buada Lagoon.

4. A significant proportion of the remaining un-mined topside *Calophyllum* forest as forest reserves and heritage sites for future generations (this would include the remaining forest areas behind Buada Lagoon).

5. Selected un-mined rocky outcrops as wildlife habitats and examples of pre-mining ecosystems.

6. Command Ridge and the railway zone of topside as a possible focus for historical and environmental-based ecotourism, once mining has ceased (this area contains the deepest mining, about 20 meters deep and the "Grand Canyon" of Nauru, and the most advanced natural regeneration in mined sites).

7. Selected noddy bird nesting sites (rookeries) and tree groves along the upper edge of the escarpment.

8. The coastal littoral zone in which all mature coastal trees within 50 m of the mean high tide line would be protected (this could include the implementation of an active program of coastal reforestation with endangered or culturally-useful salt-tolerant trees).

PROGRAM 4.2 ESTABLISHMENT OF PILOT CONSERVATION AREAS UNDER THE SPBCP

Agencies Responsible: IDI, Ministry of Justice, NIC and NECC

Potential Funding Sources: SPREP South Pacific Biodiversity Conservation Program, Nauru-Australian Cooperative Agreement Fund, Government Finances and AusAID.

Potential Sources of Expertise: SPREP, USP, SPC and appropriate overseas agencies.

Nature of Program: Once priority conservation areas and endangered species have been identified and studied, **it is recommended that a proposal be submitted to the SPREP South Pacific Biodiversity Conservation Program (SPBCP) to establish two pilot Conservation Areas (CAs) that fulfill the selection criteria for Conservation Areas suggested under Program 4.1 above.** This would include the development of a conservation area implementation and management plan.

The areas suggested for the establishment of pilot CAs are the "Anibare Bay Area" and the "Buada Lagoon Area". These areas are considered to be of highest priority due to the unique ecological importance and high visual quality of their ecosystems.

The area suggested as "Anibare Bay" is the area centred on the Anibare Bay District, extending from the Meneng Hotel to the Ijuw-Anabar mangrove ponds (this would essentially include Areas 1 and 2 listed under Program 4.1 above). This area is considered to be of highest priority due to the unique ecological importance and high visual quality of its ecosystems. This area also has the best remaining coastal and escarpment vegetation, the only extensive mangrove ecosystem, and the greatest concentration of rare and endangered vascular plant species, including two species not known from elsewhere on the Island. Thirdly,it is a primary noddy bird habitat and as such, an extremely important aspect of culture and tradition in Nauru.

Anibare Bay has comparatively few residents, and some of these have already taken part in a "Conservation of Fish Stocks and Marine Resources Workshop" with Officers from IDI (August 1995) and indicated their consent to declaring fish habitat reserves over parts of the reef flats. Being situated very close to the Meneng Hotel, "Anibare Bay" also offers great potential for recreational and ecotourism development. This site is therefore seen as being a prime candidate in Nauru for developing an appropriate Conservation Area model.

The "Buada Lagoon" area is based on the District of the same name, the only non-coastal District in Nauru, and the only part of "topside" that is not to be mined - a status that is of great interest to Nauruans. It is a perched lake on an upraised coral-limestone island, a situation that is globally unique

Buada Lagoon supports the best-developed *Calophyllum* and mango forest, and many endangered coconut and pandanus cultivars, and because of the depth of topsoil and water availability, clearly constitutes the area with the greatest existing potential for the

development of agroforestry systems. Indeed, it is possible that Buada will become the "vegetable garden and orchard" of Nauru.

The lagoon itself is a traditional aquacultural area for **ibiya** (milkfish), and although currently stocked with the unwanted tilapia, offers considerable potential for aquacultural development. The Lagoon Pond Owners Association is currently continuing efforts to remove the tilapia from the lagoon, including the possibility of introducing an edible predator species, in order to revive the nutritionally and culturally important milkfish production.

Buada Lagoon was also selected as a recommended site for the main rehabilitation nursery by the Rehabilitation Feasibility Study. Site observations indicate that the existing mango trees around and near Buada produce reasonable crops in dry years, but may be in a state of senescence (old age). If this proves to be the case, then there is an opportunity to rehabilitate these areas with selected varieties that will rejuvenate the plantation, providing import-replacement produce in a sustainable way.

It is for all these reasons that "Buada Lagoon" has been nominated as a second prime candidate for a Conservation Area model for Nauru.

The first step in the Buada Lagoon part of the program should be a detailed study of the costs and benefits of establishing an integrated sustainable agroforestry and aquacultural system based in Buada. The economic costs of foregoing mining in the area need to be weighed against the benefits of retaining and enhancing the existing environment, and savings on imported fruit, vegetables and possibly fish. Financial incentives for landowners could be considered, to encourage them to either farm the land themselves, share-farm with others, or lease to agroforestry/aquacultural interests.

The establishment of these pilot CAs may be the best way to trial the process, rather than through theoretical discussions of what might be done in practice. In this way, potential obstacles may be identified and overcome in a non-critical, but nevertheless real, situation.

The issue of landowners' rights to land zoned for conservation should be considered very early by way of consultation with the relevant people. Landowners must be intimately involved in the planning and management process at all stages, and consideration will need to be given appropriate strategies or compensation, should the establishment of a Conservation Area disadvantage or restrict landowner rights. There will be many questions along these lines that need to be resolved by consensus before any practical steps can be taken to formally establish a system of CAs.

After the Anibare Bay-Ijuw and Buada Lagoon Conservation Area Projects are commenced, efforts should also be made to interest local communities and appropriate agencies to establish other priority sites as conservation areas, or to declare the entire island of Nauru a Conservation Area or Sustainable Development Area, as suggested in Program 4.3 below.

PROGRAM 4.3 PROTECTION AND REHABILITATION OF ENDANGERED PLANTS AND ANIMALS

Agencies Responsible: IDI, Ministry of Justice, NIC and NECC

Potential Funding Sources: SPREP, Nauru-Australian Cooperative Agreement Fund, Government Finances and WWF.

Potential Sources of Expertise: SPREP, USP, WWF, SPC and appropriate overseas agencies.

Potential Funding Sources: SPREP, Nauru-Australian Cooperative Agreement Fund and Government Finances and AusAID.

Nature of Program: In addition to the identification priority ecosystems and sites for conservation, there is the need to identify individual plant and animals species that are rare or endangered, and to implement a system so that they can be legally protected and rehabilitated. It is recommended that:

1. Rare and endangered species be identified and listed in a "Register of Rare and Endangered Species";

2. Rare and endangered species be gazetted for protection by law;

3. The locations of rare and endangered species be mapped;

4. The owners of land on which rare and endangered species are found be notified of the situation and encouraged to take measures to protect and rehabilitate them; and,

5. A strategy be produced to propagate rare and endangered species and provide specimens to interested Nauruans for cultivation in their gardens or on their lands.

The register should be kept at IDI, with additional copies lodged with the Lands Commission, MWCS, NPC, the USP Centre and other appropriate locations. The register could also list certain trees or animals as "National Treasures" which can serve an educational purpose.

Once endangered species and varieties are identified and registered, and the sizes of their populations determined, measures must be taken to conserve, preserve or rehabilitate these species. This would require gazetting in the laws or ordinances of endangered terrestrial and marine species (and cultivars in the case of important cultural plants), and their formal protection under the laws and ordinances of Nauru. This is seen as one of the most important ways of both protecting endangered species and for making the public aware of those species that are endangered. Particular status could also be given to those landowners who have, protect or plant rare species or particularly good examples of rare or important plants on their land. Their names could be added to a list of "Protectors of Nauru's Natural Heritage", and the locations of

important plants could be entered into the GIS so that maps could be produced for official law enforcement and educational purposes.

PROGRAM 4.4 NODDY BIRD POPULATION BIOLOGY STUDY AND CONSERVATION INITIATIVE

Agencies Responsible: IDI, NIC and NECC

Potential Funding Sources: SPREP, Nauru-Australian Cooperative Agreement Fund, Government Finances and WWF.

Potential Sources of Expertise: USP, WWF, Environmental Consultants (Fiji) Ltd, and appropriate overseas agencies.

Nature of Program: Although the protection of noddy birds (*Anous stolidus* and *Anous minutus*) and their favoured habitat (mainly *Pisonia grandis* or **yangis** groves) are a conservation priority because of declining populations of this culturally important bird, there is little quantitative information on breeding behavior, population size and ecology, and habitat status. **It is therefore recommended that a noddy bird population biology study be conducted as a basis for the implementation of conservation initiatives.**

This program should be carried out by a professional ornithologist, with local knowledge being supplied by Nauruan assistants. Estimates need to be made of both resident and visiting birds, and recruitment to the resident breeding population. The requirements for successful breeding habitat or rookeries also need to be examined, since the noddies are apparently opportunistic in this regard (from anecdotal observations). Specific information which needs to be gathered include:

1. current size and distribution of resident breeding population;

2. size of visiting populations;

3. the extent of breeding and recruitment on Nauru; and,

4. habitat or rookery requirements for nesting and breeding;

The availability of baseline data on the noddy bird population would enable scientific management decisions to be made about the size and seasonality of sustainable hunting activity for the future, given an appropriate level or time period of protection of the breeding population. Once this information is gathered programs should be implemented to:

1. protect nesting sites; and,

2. establish rules for sustainable noddy hunting, including bag limits, seasonal restrictions, restricted areas (noddy reserves), issuance of hunting licenses or identification of hunting rights.

PROGRAM 4.5 FORESTRY AND AGROFORESTRY DEVELOPMENT PLAN

Agencies Responsible: IDI, NIC and NECC.

Potential Funding Sources: SPREP, Nauru-Australian Cooperative Agreement Fund, Government Finances and FAO/UNDP South Pacific Forestry Development Program.

Potential Sources of Expertise: USP, SPC, SPFDP, Australian Tree-Seed Centre and appropriate overseas agencies.

Nature of Program: Studies by Thaman (1990), Clarke and Thaman (1993), Thaman and Whistler (1994) have shown that the planting and protection of trees and tree-like plants have been central to the maintenance of diverse forestry and agroforestry systems throughout the Pacific, even on the smallest low-lying atolls. Ecosystem balance can be best maintained through the establishment of a highly diverse plant community. This is in contrast to the monocultural (single species) modern Western agricultural and forestry systems. **It is recommended that a forestry and agroforestry development plan be prepared to address the loss of species and cultivar diversity on Nauru and to protect and establish trees in all appropriate ecosystems on the island.** This plan could be based on, but should expand on NACRDFS "Forestry" plan (Hassall 1994). Support for the development of such a program has already been initiated by IDI with the support of the South Pacific Forestry Development Programme (SPFDP).

A priority component of the program should be the selection of the most appropriate mixture of diverse indigenous and exotic forestry and agroforestry species for revegetation and agroforestry development of Nauru (See Appendices 8-10 for information on trees and plants that should be considered for planting in Nauru).

Included as part of this activity is the promotion of mixed "organic" farming which does not depend on commercial fertilisers and pesticides. Such an activity could provide long-term ecological, economic and cultural benefits, among them protection from groundwater pollution resulting from the use of inorganic fertilisers and pesticides on low-lying limestone islands.

Priority activities of a Forestry and Agroforestry Development Program could include:

1. The active discouragement of tree removal and the encouragement of protection of trees when clearing new house sites or garden areas, protecting tree seedlings when weeding (i.e., selective weeding), and the protection and replanting of salt-tolerant coastal littoral species (See Appendices 3 and 7).

2. Replanting and rehabilitation of culturally important tree species, and important varieties of important food plants such as pandanus, coconut, breadfruit, bananas, papaya, and other appropriate fruit and cultural trees in residential and garden areas, and in appropriate inland and coastal sites.

3. Protection and planting of appropriate nitrogen-fixing plants, with particular emphasis placed on the intensified planting of indigenous legumes, such as

erekogo (*Vigna marina* and *Canavalia cathartica*), and **"Christmas tree"** or casuarina (*Casuarina equisetifolia*), plants with which the people of Nauru are very familiar.

4. The designation of the coastal or Bottomside portion of Nauru as an "Organic Farming Zone" where diversified mixed cropping is encouraged and where the use of agrochemicals is prohibited or minimised, due to the ecological and health problems created by pesticides and the use of inorganic fertilisers on low-lying islands.

5. Improvement or establishment of pig pens and pig fences, using traditional fencing materials and living, preferably edible, fencing (e.g., the use of **yangis** or other plants which have edible leaves).

6. Planting and improvement of living hedges/fencing around homes, buildings, and bordering roads).

7. Strengthening the capacity of IDI and NIC to provide appropriate planting materials and to promote village nursery and plant propagation efforts (see Program 4.6 below).

8. Planting of appropriate roadside trees, such as poinciana, casuarina and indigenous trees to provide shade and by products.

9. Conduct workshops, at the national and district levels, to develop appropriate strategies for the location, development and maintenance of a system of village-based nurseries to propagate, care for, and distribute the trees seedling and plants required for tree-planting and revegetation programs (see Program 4.6 below).

10. Conduct workshops on the post-transplanting care of plants which have been distributed or sold from the nurseries. The workshops will also focus on agroforestry, organic farming, the dangers of chemical farming in low-lying islands, and other environmental and health issues.

11. Award of yearly prizes by IDI, NIC or other appropriate bodies for the best community-based nurseries, coastal revegetation efforts, and overall tree planting and revegetation effort. Prizes could also be given to the schools that establish the best nurseries or plant the most trees. Prizes could also be awarded to individual families/landowners in each village for the best houseyard garden and associated agroforestry system, and the most trees replanted on their family land.

Species that have proved particularly useful in Nauru in the past, and which are likely to be most important species in the in the future include coconuts, pandanus. These plus other species recommended for inclusion in the forestry and agroforestry program are listed in Appendices 8-10.

PROGRAM 4.6 ESTABLISHMENT OF A NURSERY SYSTEM FOR ENDANGERED AND CULTURALLY-IMPORTANT PLANTS

Agencies Responsible: IDI, NIC, Nauru Environment Association and women's organisations.

Potential Funding Sources: SPREP, Nauru-Australian Cooperative Agreement Fund, Government Finances, UNDP, Japanese Aid, Republic of China aid, AusAID and private enterprise.

Potential Sources of Expertise: USP, SPFDP (UNDP/FAO), SPC and appropriate overseas agencies.

Nature of Program: Because many of Nauru's plants and plant varieties are rare or endangered, there is an urgent need for the deliberate propagation of many of these species. **It is recommended that a nursery system for the propagation of endangered and culturally-useful plants be established immediately.** Although the recently established NIC nursery on Topside and the small NPC ornamental plant nursery on the NPC compound are a beginning, these initiatives have not systematically attempted to propagate endangered species and other traditionally important plants, and do not contain necessary facilities or staffing expertise.

There is a need to immediately begin a systematic program for the propagation of such species. This could take the form of the establishment of a single specialist nursery, possibly in association with the rehabilitation nursery. It is also possible that the NIC Nursery on Topside could be systematically expanded to include native plants and other culturally useful plants and varieties or cultivars.

Resources will be needed to establish the nursery and training to provide the necessary skills to carry out propagation, caring for and expanding the range of required species and varieties.

This program may best be operated at the District, with financial and logistic support from NIC, the Nauru Rehabilitation Fund or from private enterprise. Planting programs could be carried out in both private households and public areas such as around schools and churches in each district. The nursery could begin with the collection of appropriate self-sown seedlings from appropriate sites on the island, the planting of seeds from fertile plants, and where possible, the vegetative production of appropriate species, such as **yangis** (*Pisonia grandis*) and pandanus, breadfruit and banana varieties. The propagation of endangered local varieties (genotypes) is preferable, as they are best adapted to the local environment. Emphasis should definitely be placed on the propagation of appropriate perennial food plants (e.g., pandanus, breadfruit, banana and pawpaw varieties, hibiscus spinach, sweet potatoes, cassava, taro, pumpkin, etc.) that can be distributed to all interested houseyard gardeners and for planting in agricultural and agroforestry reserves as part of the rehabilitation effort. Seedlings of selected short-term vegetable varieties should also be produced for distribution or sale (at a nominal price) to household food gardeners.

Valuable lessons on the propagation of indigenous coastal plants can be learned from the recently completed Tonga Coastal Protection and Reforestation Project (Faka'osi *et al*. 1995; Thaman *et al*. 1995). These include:

1. Establishment of protected areas which serve as renewable sources of products of subsistence and commercial value and sources of planting material that could be used in coastal reforestation.

2. Establishment of nurseries at national and community levels to supply planting materials for coastal reforestation programs and to protect currently endangered coastal species of particular ecological and cultural importance.

3. Employment of a wide range of propagation techniques including planting from seed (e.g., casuarina and *Calophyllum*), vegetative reproduction (e.g., *Erythrina* and *Hibiscus tiliaceus*) and transplanting of self-sown seedlings to the nursery for maturation and recovery before planting out.

4. The possibility of importing or re-introducing, from other analogous habitats or islands, and multiplying locally, species which are absent or endangered.

PROGRAM 4.7 ESTABLISHMENT OF A REHABILITATION NURSERY

Agencies Responsible: IDI, NRA and NECC

Potential Funding Sources: Nauru-Australian Cooperative Agreement Fund and Government Finances.

Potential Sources of Expertise: USP, SPC, AusAID and appropriate overseas agencies.

Nature of Program: The reforestation and revegetation of Nauru will require very large numbers of appropriate plants. **It is recommended that a "Rehabilitation Nursery" be established immediately.** The Forestry component of the NACRDFS included a detailed feasibility study for the establishment of a propagation nursery as part of the reforestation program associated with rehabilitation after mining. It was suggested that this nursery be situated on the Northern side of Buada Lagoon, on an area of about one hectare, at a capital establishment cost of $260,000 (Hassall 1994).

This nursery is additional to, and will have a separate function from the nursery recommended under Program 4.6 above, which will focus on the propagation, distribution and planting of rare and culturally important plants. There is some scope for the cooperative propagation and the development of propagation techniques for species that may be appropriate for both programs. For example, some indigenous species considered appropriate for coastal reforestation are also the most appropriate for reforestation as part of the rehabilitation of the mined-out areas. As stressed in the NACRDFS, the Rehabilitation Nursery may also provide seedlings, cutting and other planting material for other horticultural and agroforestry-based activities. It may also serve as a focus for training in, and a repository of information on the experience of, horticulture in Nauru. As such, it is thought to be of sufficient importance to include here for consideration as a separate program.

The feasibility study for establishment of this nursery has been undertaken through the NACRDFS. However, the selection of a preferred site and mechanism of leasing the site from the owners could be a useful exercise for the NECC to commission a report. Ancillary uses for the nursery, for ornamental horticulture production, may also be factored in to the economic analysis to assist the financial viability of the project and the establishment of a system of smaller, less specialised nurseries. the latter will, however, be of secondary importance.

PROGRAM 4.8 NAURU NATIONAL BOTANICAL GARDEN AND ARBORETUM

Agencies Responsible: IDI, NPC, Ministry of Education, NIC and NECC

Potential Funding Sources: Nauru-Australian Cooperative Agreement Fund, Government Finances, SPREP and other appropriate overseas aid agencies.

Potential Sources of Expertise: USP, AusAID and appropriate overseas agencies.

Nature of Program: It is recommended that steps be taken to establish a Nauru National Botanical Garden. The establishment of a Botanical Garden and Arboretum would provide a important recreational and educational resource for Nauru, would serve as a reserve for endangered and culturally valuable plants, and as a source of propagation material for selected lines of indigenous and exotic trees and plants. Such a garden could be designed with an attractive layout that encouraged use by families and limited numbers of tourists as a picnic spot, and could be used as an experimental garden for trialling new and improved varieties. A meeting place and outdoor forum space would be a useful addition for seminars and workshops on the environment.

The most appropriate site would probably be in the Buada areas, because of its superior soils and water availability. The site would probably need to be purchased or leased by the Government, and could be usefully associated with the Rehabilitation Nursery. The garden could also serve as a demonstration garden of what could be achieved under similar conditions of soil and water, whether the existing conditions in Buada, or artificial conditions subsequent to rehabilitation of nearby land.

It is recommended that the garden be organised so that there are different sections allocated for different types of plants, such as indigenous coastal and inland plants, food plants, important traditional plants and interesting ornamental plants. For example, one section could contain traditional pandanus varieties or coconut varieties. Although a single garden would be preferable, a system of smaller gardens dedicated to different groups of plants is also an option, possibly arranged on a district-to-district basis. Finally, although the Buada area seems to be the preferred location for the proposed Botanical Garden, an entirely new site could be developed as a priority use of rehabilitated land.

OBJECTIVE 5: PROMOTION OF THE SUSTAINABLE USE OF MARINE RESOURCES

The promotion of the sustainable use of marine resources is seen as one of the most important challenges for sustainable development in Nauru. Five programs are suggested.

1. Establishment of marine reserves;

2. Improvement of the fisheries resources data base;

3. Control of overexploitation of marine resources;

4. Improved exploitation of pelagic and deepwater marine resources;

5. Reinstitution of appropriate traditional marine resources management strategies; and,

6. Rehabilitation of aquaculture in Buada Lagoon.

PROGRAM 5.1 ESTABLISHMENT OF MARINE RESERVES

Agencies Responsible: Fisheries Division of IDI, MOJ, Nauru Fisherman's Association, NIC, SCUBA divers, Nauru Environment Association, Meneng Hotel, women's organisations and other appropriate NGOs.

Potential Funding Sources: SPREP SPBCP, SPC, FFA, Government Finances and AusAID.

Potential Sources of Expertise: SPREP, SPC, USP, USP Marine Studies Programme and Atoll Development Unit, UOG Marine Lab, WWF, TNC and appropriate overseas agencies.

Nature of Program: Evidence from elsewhere in the Pacific indicates that the establishment of a system of marine reserves is the single most effective means of ensuring sustainable marine resource utilisation (BioSystems 1994a). **It is recommended that a number of marine reserves be established in Nauru**.

The area that seems to the most appropriate is Anibare Bay from the Meneng-Anibare to the Anibare-Ijuw District boundaries, and including the Meneng Hotel. In this area it is recommended that all suggested fishing regulations (see Program 5.2 below) be strictly enforced and that SCUBA spearfishing be banned immediately. A similar recommendation was strongly supported at the recent "Conservation of Fish Stocks and Marine Environment Workshop" (Deiye, 1995).

Although Anibare landowners present at the Workshop indicated that they would not favor designating the entire area a marine reserve because this is their traditional fishing ground, they did indicate support for designating the reefs at the two ends of Anibare Bay as marine reserves, as long as they retained their rights to fish sustainably within the bay. It was also suggested that there was probably a need for another totally protected area of reef, possibly in Anetan or Ewa, to ensure that there will be suitable breeding sites, given the predominant current flows, to restock all Nauru's reefs.

It was stressed that, without the participation of local communities, efforts to conserve endangered species, establish effective marine reserves, and to reduce fishing pressure cannot be successful. It was stressed that further negotiations to establish Anibare Bay a limited entry marine reserve must involve all the resource users and landowners in the Anibare area.

Discussions with senior Government officials, at all levels, indicate that there is strong support for the establishment of marine reserves, with most people believing that Anibare By would be most appropriate.

There will be a need for signs proclaiming the area a marine reserve. This would facilitate community-based management as well as serving as a symbol and heightening public awareness and pride in the marine reserve.

There is also a need for a major multi-media awareness campaign (radio, newspaper) to sensitise the public and policy makers to the importance of community-based marine resource

management and the function of marine reserves in promoting sustainable fisheries resources utilisation.

PROGRAM 5.2 IMPROVEMENT OF FISHERIES RESOURCES DATA BASE

Agencies Responsible: Fisheries Division of IDI, Nauru Fisherman's Association, NIC, SCUBA divers.

Potential Funding Sources: SPREP SPBCP, SPC, FFA, Government Finances and AusAID.

Potential Sources of Expertise: SPREP, SPC, FFA, USP, USP Marine Studies Programme and Atoll Development Unit, UOG Marine Lab, James Cook University, University of Hawaii and appropriate overseas agencies.

Nature of Program: Since maximum sustainable catch (MSC) figures are not available for most species, **it is recommended that there be a program to systematically improve the fisheries data base of Nauru and to provide resource profiles on important marine species**. Although some information is available on the tuna resource and some inshore species, there is a need for better resource profiles on important subsistence and commercial species. The types of information that are required include population size and distribution, size distribution of population, habitat, biological life-cycle, feeding patterns, recruitment, cultural and economic importance and techniques use to acquire the species.

PROGRAM 5.2 CONTROL OF OVEREXPLOITATION OF MARINE RESOURCES

Agencies Responsible: Fisheries Division of IDI, Nauru Fisherman's Association, NIC, SCUBA divers, Nauru Environment Association, Meneng Hotel, women's organisations and other appropriate NGOs.

Potential Funding Sources: SPREP SPBCP, SPC, FFA, Government Finances and AusAID.

Potential Sources of Expertise: SPREP, SPC, USP, USP Marine Studies Programme and Atoll Development Unit, UOG Marine Lab and appropriate overseas agencies.

Nature of Program: It is recommended that a number of measures be taken to minimise the overexploitation of marine resources. These include:

1. A phased total ban of SCUBA-spearfishing, beginning with its prohibition in Anibare Bay, with associated public awareness programs to support the ban as a way of promoting more sustainable fisheries development.

2. Enforcement of gear restrictions, including: a) limitations on the number and size of hooks that can be used on a single line, b) restrictions on net length and minimum mesh size for gill nets, c) prohibition of the use of crow bars, and d) prohibition of the use of gillnets to catch flying fish (i.e., restriction to the use of dip nets only).

3. The limitation of catch sizes through the imposition of size limits, bag (number) limits and the issue of limited licenses for given species or fishing techniques.

4. The establishment of closed seasons, moratoria (temporary bans) or total bans on endangered or overexploited species, e.g., turban shells (**emwari**), certain species of squirrelfish and rock cod, and the prohibition of the taking of dolphins and sea turtles in support of SPREP initiatives.

5. Banning of fishing by expatriates in the reef and inshore fishery, with exception of pole-and-line fishing. This would restrict non-Nauruan fishing activities to the deepwater or pelagic species, thus, protecting over-exploited inshore resources for the subsistence and limited commercial fishing needs of the Nauruan resource owners.

6. The designation of some species for subsistence or Nauruan use only.

7. Awareness campaign for all fishers (fishermen and fisherwomen) and fish consumers on the need to use the resource on a sustainable basis and to support initiatives to promote the sustainability of the resource.

PROGRAM 5.3 REINSTITUTION OF APPROPRIATE TRADITIONAL MARINE RESOURCES MANAGEMENT STRATEGIES

Agencies Responsible: Fisheries Division of IDI, Nauru Fisherman's Association, NIC, Nauru Environment Association, women's organisations and other appropriate NGOs.

Potential Funding Sources: SPREP SPBCP, SPC, NIC, and Government.

Potential Sources of Expertise: Elderly and knowledgeable Nauruans, SPREP, SPC, USP, USP Marine Studies Programme and Atoll Development Unit, UOG Marine Lab and appropriate overseas agencies.

Nature of Program: Given the appropriateness of some aspects of the traditional marine resources management system, **it is recommended that appropriate traditional marine resources management strategies be re-instituted**. This could include:

1. Re-establishment of respect for and knowledge of seasonal cycles of marine species and means of avoiding overexploitation of important target species.

2 Encouragement of the use traditional piled-coral/rock fish aggregation devices (**enge**) on the intertidal flats for subsistence purposes.

3. Return of some control over intertidal zone (and possibly subtidal) fisheries to local communities in each District. This could include the formation of District Fisheries Management Groups. It was suggested that such groups could consist of representative of coastal and inland fishers, nominated by the Councilors of each Districts, who would be given responsibility for, and training to manage and patrol, marine resource use in their District.

PROGRAM 5.4 REHABILITATION OF AQUACULTURE IN BUADA LAGOON

Agencies Responsible: Fisheries Division of IDI, Buada Lagoon Pond Owners Association, MWCS.

Potential Funding Sources: UNDP/FAO South Pacific Aquaculture Development Project, SPREP SPBCP, SPC, NIC, and Government.

Potential Sources of Expertise: Fisheries Division of IDI, Buada Lagoon Pond Owners Association, UNDP/FAO South Pacific Aquaculture Development Project, elderly and knowledgeable Nauruans, Kiribati Fisheries Division, and appropriate overseas agencies.

Nature of Program: Although there have been recent unsuccessful attempts to remove the tilapia from Buada Lagoon, resulting in a mixed culture, **it is recommended that efforts be continued to rehabilitate aquacultural production in Buada Lagoon**. This could take the form of either further attempts to eradicate tilapia and re-establish a pure milkfish culture, or, perhaps, more realistically to develop an improved mixed milkfish-tilapia aquacultural system through the introduction of improved varieties for their improved performance and edibility. Recently, it has been suggested that a predator species, such as barramundi, be introduced from Australia to assist in controlling tilapia, a fish that is not liked as a food in Nauru.

PROGRAM 5.5 IMPROVED EXPLOITATION OF PELAGIC AND DEEPWATER FISHERIES RESOURCES

Agencies Responsible: Fisheries Division of IDI, Nauru Fisherman's Association, NIC, SCUBA divers.

Potential Funding Sources: SPC, FFA, Government Finances, Japanese AID and AusAID.

Potential Sources of Expertise: FFA, SPC, Japanese AID, USP Marine Studies Programme, UOG Marine Lab and appropriate overseas agencies.

Nature of Program: The inability of Nauru to optimally exploit its pelagic and deepsea fisheries resources is a major challenge and an area of priority development. To address this problem four activities are suggested. These are:

1. The establishment of a new deeper system of fish aggregation devices (FADS). Steps are already underway to establish 3 or more new FADS at depth of 3 to 6,000 m off Nauru to replace the former FADs that were anchored at about 1,500 m. These FADS will be based on the more durable SPC Indian Ocean design. The possibility of using discarded NPC harbour buoys as FADS is also being explored. It is believed that the establishment of a new system of FADS will both increase offshore fisheries yields as well as help to make offshore fishing more attractive to people now fishing in the inshore fishery.

2. Maintenance of strong ties and involvement with FFA for the negotiation of maximum licensing fees from foreign vessels fishing within Nauru's EEZ.

3. Revitalisation of the Nauru Fishing Corporation, in cooperation with the Nauruan Fisherman's Association, to establish an air export market for sashimi-grade tuna and other appropriate pelagic or deepwater demersal species. Given Air Nauru's current roots to the Philippines and Guam, there may be some scope for the airfreight of fresh, iced fish to the Asian and Hawaiian markets.

4. Reinforcement of a "Safety at Sea Campaign" to minimise incidence of small fishing vessels in distress or lost at sea. The Nauru Fisherman's Association and the Fisheries Division IDI have commenced a "Safety at Sea Awareness Campaign" and the Fisheries Division hosted an FFA-funded outboard maintenance workshop in early 1996 to address this issue.

OBJECTIVE 6: PEST AND DISEASE CONTROL

As stressed in Chapter 4, the lack of quarantine regulations and facilities in Nauru, the increase in populations population of pests and disease vectors such as flies, mosquitoes, cockroaches, rats, feral dogs, cats and pigs, the increasing competition of exotic weedy species with remaining indigenous vegetation, and the potential danger of the introduction of very serious pests such as the brown tree snake or malarial mosquitos constitute an important environmental issue. Also of concern is the possibility of introducing serious pests or diseases into the marine environment in the ballast or bilge water brought into Nauru in phosphate vessels. Pest and disease control is, thus, seen as a priority objective of the NEAP. Two main programs are suggested:

1. The establishment of an Integrated Pest and Disease Control Program, and

2. The establishment of a Quarantine Service.

PROGRAM 6.1 ESTABLISHMENT OF AN INTEGRATED PEST AND DISEASE CONTROL PROGRAM

Agencies Responsible: IDI, MHMS, NPC, Immigration Service?, Ministry of Justice, women's organisations and other appropriate NGOs

Potential Funding Sources: SPC Plant Protection Programme, SPREP, Government Finances and AusAID.

Potential Sources of Expertise: SPC, USP Alafua and appropriate overseas agencies.

Nature of Program: To strengthen pest and disease control in Nauru, it is recommended that an integrated pest and disease control program be established immediately. The program should have an integrated approach that utilizes educational, inspection, enforcement and other pro-active components. Implementation should be under the relevant Government Department, possibly the Ministry of Health and Medical Services. If the Government is seen to be achieving results through the actions of their officers, public confidence will follow, and educational and inspection activities will be better received.

Examples of pro-active campaigns that could be incorporated into this program include:

1. Implementation of regular and controlled spraying for mosquito control.

2. Establishment of feral animal trapping service.

3. Enforcement of existing regulations on importation of dogs.

4. Establishment and enforcement of regulation on keeping of pigs in urban situations.

In all these cases, the communication of Government's intent and resolve should be included through appropriate publicity. Domestic public awareness campaigns should then follow to promote such activities as:

1. Removal of mosquito and fly-breeding sites from households compounds.

2. Improved hygiene associated with household pig-pens.

PROGRAM 6.2 ESTABLISHMENT OF A QUARANTINE SERVICE

Agencies Responsible: IDI, MHMS, NPC, Immigration Service? and Ministry of Justice

Potential Funding Sources: SPC Plant Protection Programme, SPREP, Government Finances and AusAID.

Potential Sources of Expertise: SPC, USP Alafua and appropriate overseas agencies.

Prevention is always better than cure, and this is never more true than in the case of plant and animal quarantine. As stressed in Chapter 4, at this point in time, pest and disease organisms (whether plant, animal or microorganism) can be introduced un-checked to Nauru through air and sea transport terminals. Because this could have drastic impacts on human health, future agricultural production and on Nauru's environment and biodiversity, **it is very strongly recommended that a Quarantine Service be established immediately.**

A Nauru Quarantine Service would oversee:

1. Inspection and fumigation, if required, of all imported fresh food, plant and animal material.

2. Inspection of all planes, luggage and cargo arriving from Guam to ensure that the brown tree snake in not introduced into Nauru.

3. Ensuring that incoming ships dump ballast or bilge water at least 15 km before reaching Nauru to ensure that marine pests and disease organisms are not introduced into Nauru's reef ecosystems.

4. Arrangement of bilateral agreements with trading partners on quarantine issues.

5. Maintenance of a register of likely or potentially dangerous and prohibited imports.

6. Issuance and administration of import licensing, including conditions and possible pre-treatments for some products.

OBJECTIVE 7: POLLUTION AND WASTE MANAGEMENT

As outlined in Chapter 4, the issues of air, noise, oil and water pollution and waste management are of serious concern in terms of their impact on both the natural and urban environments and human health, and will require strategies for prevention and management at all levels of Nauruan society.

Programs that are recommended to address these issues include:

1. Development of an Integrated Waste Management Plan and the establishment of a Waste Management Authority.

2. Waste reduction campaign.

3. An education program for the safe handling and proper disposal of pesticides and chemicals.

4. Strengthening of recycling capabilities.

5. Green waste recycling.

6. Establishment of a sewage treatment plant, and investigation of appropriate alternative sanitation systems.

7. A composting toilet trial.

8. Air pollution monitoring and control.

9. Noise pollution control.

PROGRAM 7.1 DEVELOPMENT OF AN INTEGRATED WASTE MANAGEMENT PLAN AND THE ESTABLISHMENT OF A WASTE MANAGEMENT AUTHORITY

Agencies Responsible: IDI, NECC, NPC, MWCS, NIC, NGOs and individual households.

Potential Funding Sources: Nauru-Australian Cooperative Agreement Fund, Government Finances, NPC earnings, NIC budget and other appropriate sources or agencies.

Potential Sources of Expertise: NPC, NIC, MWCS, AusAID.

Nature of Program: The collection of solid waste in Nauru is currently irregular and undertaken partially by each of NIC, NPC and PWD, and not all households are serviced. There is an urgent need to locate a new landfill site and to regulate the way in which solid waste is disposed. It is recommended that an Integrated Waste Management Plan be developed and that a single Waste Management Authority be established. Part of this recommendation is the need to identify a new landfill site(s), which will be designed and managed according to modern principles to minimise pollution of groundwater and other potential health and environmental impacts.Part of the integrated waste management plan would be a waste reduction and re-use or recycling campaign. This is discussed under Program 6.2 below.

A similar recommendation was included in the NACRDFS report regarding the location, design and management of waste disposal. It was recommended that an integrated waste management strategy be implemented that incorporates the various waste streams and energy output, including considerations of irrigation and water supply and waste water treatment.

A crucial recommendation that is reiterated here is that Waste Management should be efficiently administered under a single authority. Details are provided in the report of alternative methods of design for landfill sites, and costing of different collection systems. These should be reviewed by the NECC and recommendations forwarded to cabinet through IDI.

An important component of an integrated waste management plan must be the development of a toxic, chemical and bio-waste disposal capability to deal with wastes such as fuels and lubricants, paints, solvents, heavy metals, pesticides, fungicides and other industrial chemicals, bio-wastes from medical facilities, and cadmium sludge.

It is recommended that toxic waste and chemicals be collected and stored in separate skips prior to safe disposal, instead of being mixed with general household refuse. Subsequent disposal may involve re-export or disposal in specially designated and designed toxic waste disposal sites.

In terms of the storage and waste disposal of fuels and lubricants, no facilities currently exist for recycling or safe disposal. Engine oil in particular has a potential to be filtered and recycled, but for this to occur, a collection and storage mechanism is needed.

NPC is currently up-grading the fuel storage and distribution facilities in the light of safety concerns and to comply with international standards. It is recommended that an Fuel and Lubricants Environmental Management Plan be produced and implemented as soon as possible to cover pumping, storage, fire and safety protection. This could be coordinated through the existing energy committee or by the suggested Waste Management Authority.

Bio-wastes from medical facilities also need to be separated from the general solids, and a suitable incinerator established at the new controlled landfill site, away from residential sectors.

According to the NACRDFS Report, the options for containing the cadmium from the "slime dump" involve

"moving, sealing or controlling seepage and runoff. Sealing is technically feasible, but would incur significant costs. There may be scope for a cheaper, compromise arrangement whereby surface runoff is drained around and away from the site. It is important to know the chemical form of the cadmium, so as to better understand the way in which cadmium is transferred from waste to soils, to plants, animals and people under the conditions prevailing in Nauru. If the cadmium is insoluble, then even when it is at a high level, the consequences for people in Nauru may not be great. It is also known that cadmium tends to be chemically "fixed" in soils which are alkaline (and those of Nauru are highly alkaline)".

PROGRAM 7.2 WASTE REDUCTION CAMPAIGN

Agencies Responsible: IDI, ECC, NPC, MWCS, NIC, TV, Radio and Newspaper media, NGOs and individual households.

Potential Funding Sources: Government Finances, NPC earnings, NIC budget, private enterprise, and other appropriate sources or agencies.

Potential Sources of Expertise: NPC, NIC, MWCS, AusAID.

Nature of Program: The reduction of waste and prevention of pollution is much more cost-effective than clean-up and disposal. Efforts should be made to reduce waste volumes through restrictions on imported packaging, reduction in use of plastic bags, and the initiation of appropriate re-use and recycling activities. It is recommended that a Waste Reduction Campaign, including the promotion of re-use and recycling activities, be mounted as an integral component of the Integrated Waste Management Plan. Such a campaign will have to be well-planned and supported by a media advertisements. The benefits would be two-fold. Firstly, there would be a reduction of waste, some of which is dangerous to human health and to the environment (e.g., broken bottles and the burning of some plastics). Secondly, there would be economic benefits arising out of purchasing materials with less packaging, lower costs of disposal, and savings or earnings arising out of reuse and recycling activities (e.g., the composting of appropriate wastes and the re-exporting of scrap metal and aluminium).

It is also recommended that consideration be given to the introduction of deposits on bottles and other containers. This is a simple measure that will assist in the re-collection of packaging at points of sale, and involve the merchants in assuming some responsibility for the products they import and sell.

PROGRAM 7.3 EDUCATION PROGRAM FOR THE SAFE HANDLING AND PROPER DISPOSAL OF PESTICIDES AND CHEMICALS

Agencies Responsible: NIC, MWCS, MOE, IDI, NPC

Potential Funding Sources: Government finances, SPREP, SPC

Potential Sources of Expertise: SPREP, SPC, USP, Chemical supply companies and importers

Nature of Program: The use of pesticides and chemicals is currently restricted to periodic spraying to control mosquitos and other disease vectors and the household use of commercial insecticides and other widely available chemical products. It is expected that their use in Nauru will increase with the development of agriculture, agroforestry and animal husbandry projects (for the control of pests and diseases), and with the introduction of new industries, such as soft-drink manufacturing, that require the use of new chemicals. This program would aim to teach Nauruan people about the potentially harmful effects of different kinds of pesticides and chemicals, and the best and safest ways to store, use and dispose of them so they do not constitute a hazard to human health and the environment.

The program could be focussed on both the school system and the general public, with workshops and training sessions, particularly for those persons who will distributing, using or disposing of pesticides and chemicals.

Each pesticide or chemical that is introduced to Nauru should have an accompanying safety data sheet provided by the manufacturer to explains the nature of the constituents and their possible hazardous properties. This information should be provided in accordance with International Standards of Quality Assurance, and also be summarized on the labels of all containers in which the chemicals are sold. A complete record of all such data sheets should be permanently kept by the importing agent in Nauru, on behalf of the manufacturer. Posters on the different classes of pesticides and toxic chemicals should be made available to schools and community groups. SPREP and SPC currently have programs which could assist Nauru in the development of this program

PROGRAM 7.4 STRENGTHENING OF RECYCLING CAPABILITIES

Agencies Responsible: NPC, Works Department, NIC, NGOs and individual households.

Potential Funding Sources: Nauru-Australian Cooperative Agreement Fund, Government Finances, SPREP, UNDP, NPC earnings, NIC budget and other appropriate sources or agencies.

Potential Sources of Expertise: SPREP and appropriate overseas agencies.

Nature of Program: There is a small aluminium can recycling operation currently run by the NIC as part of its commitment to environmental management. Unfortunately, it appears from enquiries made by NIC that it is not financially feasible under the present situation, to return crushed glass to Melbourne for recycling. If a deposit is added to the price of these items as suggested above, recycling may become possible in the future. It is recommended that the aluminium can recycling program in Nauru be strengthened, and possibly expanded to include other aspects of recycling or waste separation and management.

Such a program could provide a source of revenue for NIC, as well as serving a very important role in an Integrated Waste Management Program. To initiate the strengthening, a Business Plan needs to be written and seed funding obtained by Government for equipment procurement and staffing. The program should be self-sustaining, however, in the medium and long term, and may even be privatized at a later stage.

The existing collection and crushing of aluminium cans for re-export could have a greater positive economic benefit if payment is made for the return of cans to the recycling centre. It is recommended that a deposit be charged on all drink cans sold from a certain date, as an incentive to recycle directly from the home or end-user, and collection bins could be located at points of sale. The collection of illegally dumped cans could also be encouraged by children on a voluntary basis, and/or as a community service punishment for minor offenses (so many dollars fine, or so many cans collected!).

It may also be appropriate to consider a ban on the importation of beer in bottles, as bottles can not be recycled and re-exported. The apparently increasing use of beer in bottles (e.g., the new trendy "ice" and "cold" beers) could lead to a drastic increase in the amount of broken glass on the island, which constitutes a human health problem, a problem which has not existed in the past due to the almost exclusive import of beer in aluminium cans. There is a possibility that crushed glass could be used as fill material and as a constituent in concrete mixes in the construction industry, if it can be efficiently collected and supplied to the market.

Other opportunities for recycling may be limited by the low volumes of different waste materials produced in Nauru, although the NECC and NIC and importers should be encouraged to explore all options. The return of shipping containers to the point from which they were imported may provide the opportunity to re-export some items such as non-ferrous scrap metals, or recyclable plastics. Any recycling activity will reduce waste management costs and reduce the demand for landfill, both of which should be important aims.

The efforts of NPC to organize the removal of all scrap metal from topside dump sites should also be supported, with the proviso that perhaps a representative museum of machinery be retained for future interest and tourism potential. In addition, no World War Two relics should be allowed to be removed from Nauru.

PROGRAM 7.5 GREEN WASTE RECYCLING

Agencies Responsible: NPC, MWCS, NIC, NGOs and individual households.

Potential Funding Sources: Nauru-Australian Cooperative Agreement Fund, Government Finances, NPC earnings, NIC budget and other appropriate sources or agencies.

Potential Sources of Expertise: AusAID and other appropriate agencies.

Nature of Program: There is currently a large number of trees that are removed in the phosphate mining process and garden waste that is burned or disposed of either in landfills or other inappropriate sites on the island. It is recommended that a green waste recycling program be established to utilise these wastes in the production of compost and new soil ("emwarere tsimeduw").

The NACRDFS report recommended the use of a wood chipper or mulcher to produce mulch from wood and other green waste. The effect of this would be to reduce smoke and greenhouse gases from the burning of vegetation at both the household and institutional levels, and reduce the volume and therefore cost of waste handled at the landfill. The green waste will also provide a beneficial compost for use in gardens and the manufacture of soil, both for household or institutional use and for the rehabilitation of the island.

Interest has been expressed by both NIC and NPC in obtaining a mulcher/wood chipper facility for reducing green waste to a very usable, easily composting, material. Funding could be sought for the importation of two machines, to handle different sized material. Firstly, a medium sized mulcher could be purchased to service households and NIC tree-lopping activities. A larger machine could be used to wood chip the trees being cleared for phosphate mining on Topside, and any heavier work.

PROGRAM 7.6 ESTABLISHMENT OF A SEWAGE TREATMENT SYSTEM

Agencies Responsible: NPC, MWCS and IDI.

Potential Funding Sources: Nauru-Australian Cooperative Agreement Fund, Government Finances, NPC earnings, and other appropriate sources or agencies.

Potential Sources of Expertise: Overseas experts.

Nature of Program: As stressed in Chapter 4, the solution to eliminating biological pollution from Nauru's groundwater system lies in the adequacy and management of the sewerage system. It is recommended that a Sewage Treatment System be established in Nauru.

NPC has indicated that it is considering the purchase of a treatment plant for sewage. The current discharge of sewage affects the operation of the power station and desalination plant by blocking filters and intakes, as well as polluting the reef! The treatment plant would need to be designed to accept the effluent from household and institutional sources under the current collection system, without the need for further reticulation.This system comprises a combination of pumped-out septic tank and cess-pit contents, and the salt-water reticulation system used within the NPC compound.

The options of secondary and tertiary sewage treatment need to be discussed, depending on the quality of liquid output that is required and the ultimate uses to which it is to be put. There is potential to use the dried sludge component as an ingredient in artificial soil production and the waste water for use for landscaping, agricultural production, golf course maintenance and houseyard gardens. Responsibility for the overview of system operation and maintenance, and quality testing program, also need to be agreed between all stakeholders.

Serious consideration will need to be given to the siting of such a plant in relation to proximity to residences, both existing and planned. The NACRDFS land-use plan should be reviewed in this regard. For any new residential development, a reticulated sewerage system should be planned as part of the infrastructure, or alternatives such as composting toilets should be considered (see Program 7.7 below).

PROGRAM 7.7 COMPOSTING TOILET TRIAL

Agencies Responsible: NIC, MWCS, IDI and NECC

Potential Funding Sources: Nauru-Australia Cooperation Agreement Fund, Government finances

Potential Sources of Expertise: AusAID, Australian consultants and suppliers

Nature of Program: As stated above, many of the wells on bottomside exceed WHO standards for pollution with coliform bacteria, and cannot be used for drinking water. The source of this pollution is assumed to be the uncontrolled discharge from septic tanks and cess-pit toilets, and the leachate from garbage dumps and animal activities, directly into the groundwater.

Some families still use pit latrines, and most homes outside of the NPC compound are not connected to a reticulated sewer system. It is recommended that a Composting Toilet Trial be undertaken, with the objective of testing an appropriate technology that will keep faecal material away from the water table, and which will provide valuable fertiliser needed to increase soil productivity on the island. If uncontrolled dumping of garbage at the residential level can be removed at the same time by Regulation, the water quality of the groundwater lens is expected to be greatly improved.

Composting toilets have recently been trailed on Kiritimati Island, Kiribati, as part of an AusAID program. The toilets were introduced into that situation for precisely the same reason as suggested above, and are proving very successful. The technology has been known for about fifty years in more temperate climates, but a number of modifications in the recent trial have proved more efficient and cost-effective for tropical Pacific applications.

The composting toilet basically utilises a concrete block chamber that is isolated from the surrounding environment, and in which the faecal matter and a bulking agent (e.g., coconut coir and raked leaves) are aerobically decomposed to form a stable, compost-like end-product. The environmental benefits include the fact that no water is used in the system, the design ensures that no odour is emitted, the groundwater is not affected, and a useful compost is produced that is suitable, with some safeguards, for use as a fertilizer. The units can be designed to cater for individual families, or small community groups, and can be free-standing, or built-in to existing structures. They are available from several different manufacturers overseas, but most components could be built in Nauru to an existing design.

PROGRAM 7.8 AIR POLLUTION MONITORING AND CONTROL

Agencies Responsible: NPC, MWCS, NIC and MHMS.

Potential Funding Sources: Government Finances, NPC, NIC, SPREP and other appropriate sources or agencies.

Potential Sources of Expertise: SPREP, USP and appropriate overseas agencies.

Nature of Program: The issue of air pollution in Nauru is restricted to concern for the possible harmful effects of phosphate dust and motor vehicle emissions. The latter should be addressed by considering the switch to unleaded fuels, and enforcing high levels of maintenance on private and public vehicles, especially those with diesel engines.

The possible health implications of dust and of cadmium in Nauru need to be investigated and the levels of these pollutants monitored. All practicable measures should be taken to reduce human intake by humans. In particular, the health of workers in the phosphate drying area needs to be closely monitored.

NPC has indicated that it wishes to renovate the existing electrostatic precipitators with an objective of recovering the phosphate for sale that is now lost as dust. This initiative is strongly supported and would reduce phosphate dust levels considerably.

PROGRAM 7.9 NOISE POLLUTION CONTROL

Agencies Responsible: Air Nauru, NPC, MWCS, NIC and individual households.

Potential Funding Sources: NPC earnings, NIC budget and other appropriate sources or agencies.

Potential Sources of Expertise: NPC, NIC, AusAID.

Nature of Program: Although not of great current concern, except in Boe and Yaren Districts, there is a need to have a policy to minimise levels of noise pollution. In relation to the airport, little can be done except for the scheduling of flights at appropriate times, choice of aircraft and the design of housing to minimise noise pollution. Laws or campaigns may be enacted to minimise noise pollution from amplified music, in specified zones, such as near the hospital, near schools, churches and government buildings. It may be possible to install sound-deadening materials in classrooms, meeting rooms and other appropriate places that are overly affected.

With respect to future industrial or noise generating developments, some of which that may generate high sound levels, there is also a need for zoning or planning regulations to locate these in the most appropriate places or to incorporate sound control features in the building design.

OBJECTIVE 8: CONTROL OF POPULATION AND URBANIZATION

To minimise pressure on scarce natural and financial resources due to overpopulation and urbanisation there is a need to:

1. Implement an effective family planning program,

2. Develop new residential and agricultural areas as part of the rehabilitation of Nauru, and

3. To place limits on immigration into Nauru.

PROGRAM 8.1 FAMILY PLANNING PROGRAM

Although there may be resistance to the implementation of a family planning program in Nauru, this is seen as necessary if Nauruans expect to maintain the same standard of living to which they are accustomed. **It is recommended that efforts be directed to limiting the size of Nauruan families and to strengthening family planning**.

To do so will require a multi-media campaign to emphasis the benefits to individual families and to the future well-being of all Nauruans, in terms of living within the carrying capacity of their island environment. Women's groups, Church groups and the Education Department should play prominent roles in such a program. Funds could be solicited from the United Nations Fund for Population Activities (UNFPA).

PROGRAM 8.2 PLANNED HOUSING DEVELOPMENT

Carefully planned housing development is an important means of addressing uncontrolled urbanisation and population increase. This could take the form of either zoned housing or encouraging land owners to build new housing with minimum disruption to the environment (e.g., protecting or incorporating endangered or culturally important trees or ecosystems into the landscaping). At present, the indiscriminate clearance of all trees, including coconuts, from new housing sites is a common practice.

An integral component of planned housing development in Nauru must be the provision of appropriate housing, recreation areas and garden reserves as part of the rehabilitation of Topside. This is covered in detail in the NACRDFS report. The development of residential areas and associated services and infrastructure on Topside would take pressure off Bottomside, particularly coastal sites, and would help to accommodate the housing and other needs of future generations.

PROGRAM 8.3 IMMIGRATION CONTROL

Given the limited resource base of Nauru, it is recommended that immigration be controlled so that only people essential to the development of Nauru be accepted as immigrants. Given the shortage of land, the limited marine and terrestrial resource base and the limited scope for paid employment and economic enterprise, uncontrolled immigration can only create long term problems and greater pressures on an already stressed resource base. **It is, thus, recommended that government implement and enforce a workable immigration policy that supports the objective of sustainable development, while at the same time keeping population levels within the carrying capacity of Nauru's environment.**

OBJECTIVE 9: HEALTH AND NUTRITION IMPROVEMENT

As stressed in Chapter 4, without human health, there is limited incentive for people to worry about maintaining a healthy environment. Although the people of Nauru are generally well-fed and healthy, there are serious nutritional problems and health disorders which need to be addressed.

The two main programs that are suggested to bring about an improvement of health and nutrition in Nauru are:

1. A Health and Nutrition Awareness and Improvement Campaign, and

2. A Physical Fitness Campaign.

PROGRAM 9.1 Health and Nutrition Awareness and Improvement Campaign

There is a need for a focussed Health and Nutrition Awareness and Improvement Campaign to address the breakdown in the traditional food systems, the high incidence of non-communicable diseases. To do so there may be a need to establish a Nauru National Health and Nutrition Committee similar to what has been done in most other Pacific Island countries.

Some of the components of such a campaign, in terms of both increasing public awareness and action programs to address nutrition-related problems, could include:

1. Promotion of prolonged breastfeeding.

2. Promotion of the consumption of local foodstuffs and fresh fruits and vegetable (e.g., fresh fish, pandanus, pawpaw, coconut, bele, etc.).

3. Promotion of the consumption of fresh water, toddy, coconut, lemon-grass tea and local fresh drinks instead of sugar or alcohol-rich drinks.

4. Promotion of home food gardening and the protection and planting of local food trees/crops (e.g., coconuts, pandanus, breadfruit, bananas, papayas, mango and lime trees).

5. Rehabilitation of coconut and pandanus plantations.

6. Establishment of food garden reserves and fruit-tree. orchards as components of Topside rehabilitation.

7. A dental hygiene awareness campaign, with primary focus on school children.

Some of the components, which could address other health issues include:

1. A program to discourage drinking and driving, with legislation and appropriate enforcement for drunk driving violations.

2. An anti-smoking Campaign.

3. A Safety-at-Sea Awareness Campaign.

4. Improvement of household environmental health (e.g., improved water supply, clearance of fly and mosquito-breeding sites, and isolating pigs from garbage dumps).

5. Strengthening of health and personal hygiene instruction in schools.

6. An STD and AIDS awareness program for all sectors of society, particularly people who travel frequently to AIDS-infected areas and other high-risk groups, and the continuation of the blood-screening program for AIDS, hepatitis-B and other appropriate diseases.

7. Expansion of immunisation programs for Hepatitis-B and other appropriate diseases (the current immunisation program for Hepatitis-B is restricted to pre-school-age dependents of NPC employees and hospital employees).

PROGRAM 9.2 Physical Fitness Campaign

Physical fitness campaigns, such as the "Life Be In It" campaign in Australia have been very successful in raising national awareness of the benefits of physical exercise and improved physical fitness as a foundation for longer and more productive lives. Some of the initiatives or programs that could be implemented or re-enforced in Nauru include:

1. Continue and intensify the "Life Is Beautiful" fitness awareness campaign sponsored by the Nauru Ministry of Sport and the Nauru Olympic Committee, which has been designed to correspond with the buildup for the participation of Nauru's Commonwealth weightlifting champion's participation in the 1996 Olympic Games in Atlanta.

2. Improve sports facilities and programs, and encourage their regular use (e.g., the development of the NPC Fitness Center and the Women's Fitness Classes).

3. Conduct anti-smoking campaigns and ban smoking in government offices and public places to eliminate passive smoking and cigarette pollution and to protect government from liability for employees contracting lung cancer or other smoking-related illnesses.

4. Conduct campaign to encourage moderate consumption of alcohol.

5. Promotion of low-fat, low-sugar and low-salt diet.

OBJECTIVE 10: PROMOTION OF SUSTAINABLE ECONOMIC DEVELOPMENT

The objective of promoting sustainable economic development is a relatively new direction for Nauru, which is currently operating within an uncertain World economy. The income from phosphate mining is in decline, and solely dependent on demand from importing countries. Replacement industries are required that will generate the foreign exchange needed to continue trade with other countries. Two of the most promising industries with potential for the replacement of phosphate income are Fisheries and Tourism. There is also a need to strengthen subsistence production for both economic and health reasons. Programs for strengthening local provision of basic needs and developing a viable tourism industry include

1. The strengthening of local production systems,

2. The development of a Tourism Master Plan, and

3. Ecotourism development.

PROGRAM 10.1 STRENGTHENING OF LOCAL PRODUCTION SYSTEMS

Agencies Responsible: IDI, NIC, NRA

Potential Funding Sources: Government Finances, Rehabilitation Fund, Agricultural Technical Mission from the Republic of China Private Investment, other external aid sources.

Potential Sources of Expertise: IDI, PRAP, SPC, USP, FSP, Agricultural Technical Mission from the Republic of China

Nature Of Program: The strengthening of local production systems is seen as a priority, given the unstable nature of the world market economy and the increasing costs of imported foods, beverages and other consumer goods. A maximisation of the production of local foodstuffs would help Nauru's balance of payments and cash flow problems and protect local people (particularly poorer people) from rapid inflation in the costs of imported goods. It would also help to produce local foods that could lead to an improvement in nutrition-related health in Nauru.

The promotion of sustainable fisheries production for local needs is discussed in detail under Objective 5 above. The establishment of nurseries and the development of an agroforestry system are discussed above under Land Rehabilitation and Protection and conservation of biodiversity in Objectives 1 and 4.

As stresses in Chapter 4, the strengthening of local production should focus on plants and products that have been proven in the Nauru environment. Priority activities, at the household level, should include

1. The re-establishment and rehabilitation of coconut plantations, Nauru's main staple food and the source of toddy, fuel, fibre, mats and other plaited ware and a wide range of other useful products.

2. The planting of a range pandanus cultivars which produce edible fruits and fibre even in times of severe drought.

3. The planting of a range or proven food trees such as breadfruit, bananas, pawpaw, mango, horseradish tree (*Moringa oleifera*).

4. The planting of proven vegetables such a swamp spinach (*Basella rubra*), hibiscus spinach or **bele** (*Abelmoschus manihot*), Chinese cabbage, spring onions, cassava and sweet potato, all which grow well in some areas of Nauru.

5. The encouragement of small-scale home production of pigs and chickens based on the used of domestic and agricultural waste and foraging as food sources (this will require better training or control of dog populations that currently devastate chicken populations). Experience elsewhere on small islands in the Pacific have shown that large-scale pig and poultry production, which depends on expensive

inputs that are subject to inflation, has rarely been successful, and that traditional small-livestock husbandry systems are far more appropriate.

6. The encouragement of the production or use of a range of other appropriate traditional or new locally produced products, including proven traditional medicines, leis and garlands, shell necklaces, local handicrafts, firewood, etc.

Some of these activities are already being promoted by NIC and the Agricultural Technical Mission from the Republic of China. There is, however, a need to designate an individual (e.g., an Agricultural Officer) in IDI who would be responsible for the systematic promotion of the above programs by individual households and landowners.

A national competition for the best Home Production System could be conducted, along the lines of, or along with the annual home flower garden competition. Criteria for such a competition would focus on the homeowners that have the best production based on categories 1 to 6 above.

PROGRAM 10.2 DEVELOPMENT OF A TOURISM MASTER PLAN

Agencies Responsible: IDI, Air Nauru, Meneng Hotel, Od-N Aiwo Hotel, Chamber of Commerce, Private Enterprise

Potential Funding Sources: Government Finances, Private Investment, other external aid sources.

Potential Sources of Expertise: IDI, Tourism Council of the South Pacific, Private Investors, overseas consultants

Nature Of Program: Nauru is well placed to benefit from tourist traffic, being nearly equidistant from Japan and Australia. The air transport infrastructure is already in place, connecting directly to several potentially large markets in the Asia-Pacific region. In addition, the newly renovated Meneng Hotel provides accommodation of an international standard, and Nauru owns several other hotels in overseas cities. Thus a great deal of capital investment has already been made in this industry, and it's sustainable development potential is widely acknowledged. **It is recommended that the design of a Master Plan for the sustainable development of tourism in Nauru would be a natural starting point**

Nauru is not presently a major end-destination for tourists, but acts as a staging point for travellers using Air Nauru to reach other Asia-Pacific destinations. Olsson (1995) estimated that, of the 10,000 people who travelled to Nauru in the latter half of 1994, 25% were tourists and 11% were same-day transit visitors. A further 53% were travelling on commercial or Government business, and some of these would be expected to spend some of their time sight-seeing. Thus, the existing potential market could comprise between 5,000 and 10,000 tourists per annum, or 100 to 200 per week.

According to Olsson (1995), the primary objective of Nauru's tourism strategy is to:

> bring about the development of a sustainable tourism industry that contributes to economic, environmental and social well-being, and at the same time protects and enhances opportunities for the future. . . . the main thrust will be on preserving and enhancing existing natural and cultural assets and avoiding over-commercialisation.

The writing of a master plan for Tourism Development in Nauru could assess the overall future potential, both for Nauru as an end-destination, and as part of a Micronesian tour of perhaps three or four Island groups. It will provide a vision for development of an industry that will bring economic gains to the Nation, especially the provision of future employment for young Nauruans.

The principle of sustainability should be adhered to when assessing the economic potential, with special regard to the environmental and social impacts that tourism generates. For example, limits may be placed on the number of tourists permitted at any one time, so that the

essential experience of being in Nauru is not lost. The Master Plan should express, as a matter of priority, the fact that environmental protection of Nauru's remaining undisturbed areas is critical for the tourism industry. It is well understood that the qualities of the place - the landscape, the climate, the flora and fauna, the people - determine the level of interest in visitation of a destination.

Given that capital investment in tourism infrastructure has already been made, one approach to the Master Plan may be to identify and catalogue the features and areas of Nauru that overseas visitors may wish to see or experience. This involves an appraisal of what parts of Nauru's natural and cultural history would be attractive for different sectors of the tourist market. These marketing strengths need to be assessed relative to the attractions of other regional destinations, and placed in the context of the kinds of tourists who now visit the region. This kind of survey may lead to the identification of a package concept for "niche" type tourists - of the "adventure" or "comfortable adventure" kind - who enjoy visiting small, isolated places to undertake self-guided or "discovery"-type tours. Opportunities in Nauru for these people would include deep-sea fishing, skindiving, noddy-bird hunting, frigate-bird capturing, caving, natural history of raised atolls, touring World War II installations, phosphate mining history, and eventually, rehabilitation technology.

The Ministry of Island Development and Industry has recently established a National Culture and Tourism Office (CTO) to facilitate and implement policies and programs in this regard. This Office should provide the coordinating and administrative role in establishing a committee of stakeholders from the hotel, airline and other tourism sectors to formulate the Master Plan.

PROGRAM 10.3 PROMOTION OF ECOTOURISM

Agencies Responsible: IDI, Air Nauru, Meneng Hotel, Od-N Aiwo Hotel, Chamber of Commerce, Private Enterprise

Potential Funding Sources: Government Finances, Private Investment

Potential Sources of Expertise: IDI, Private Investors, overseas consultants

Nature of Program: One form of tourism that does not require intensive inputs, and is therefore sustainable, is ecotourism. This form of tourism has been steadily gaining acceptance as a specialty area of the industry. Ecotourism is defined as presenting the natural environment to visitors in a manner that maintains its integral natural and cultural features, while providing the visitor with an enjoyable and educational experience. In the case of Nauru ecotourism would also include highlighting traditional and modern uses of land and marine resources by the Nauruan people.

The involvement of the Nauruan people will improve the quality of the ecotourism experience, and provide new opportunities for employment and the provision of local goods, services and facilities. It is recommended that a discussion paper be produced by IDI for presentation and discussions held with the Nauruan stakeholders to explain the key principles of ecotourism, and to identify resources and opportunities in Nauru.

The NACRDFS (1994) report proposed Command Ridge and Railway Zone of topside as a possible focus for historical and environmental-based ecotourism, once mining has ceased. One result of this would be that this area would not be residually mined or rehabilitated, in order to keep the pit and pinnacle topography left by the pre-1938 hand-mining methods. This area was found to contain the deepest mining (about 20 m) and the most advanced natural regeneration in mined sites. It was recommended that this "Grand Canyon of Nauru" be preserved for future scientific study of the regeneration process.

A management plan could be written for ecotourism that would provide a variety of unique experiences. Interpretative trails could be built through the area, offering different grades of walks, the more difficult of which would include a climb up the tallest pinnacles at Command Ridge. For historically-minded groups, guided tours could be offered through Japanese World War II fortifications, and a small Museum to house artifacts has already been established by NPC as part of its 25th Anniversary Celebrations in 1995. These facilities would also be of educational benefit for Nauruan School-children who are studying the history of their island.

In the future, tourist trains could run on the railway to the Topside Workshops, as one way of viewing the pinnacles. A concept plan could quickly be commissioned and presented to a trial audience of possible agents or tour leaders from the major market countries. Full consultation with the landowners would be needed from the very beginning, with the aim of a co-operative approach to running and manning the project.

OBJECTIVE 11: APPROPRIATE INFRASTRUCTURAL DEVELOPMENT

The design and construction of appropriate infrastructure and services in Nauru is basic to the strategy for sustainable economic development. The provision of efficient services, such as water, power supply and transport, will facilitate the introduction of new industry and other appropriate development, and could be the difference between success and failure. Fortunately, this is also consideration of this issue in the NACRDFS, with particular reference to land use planning for topside.

There is also a need to consider both the extent of services to be provided by Government for new developments, and the quality or standards of those services. The best way to make decisions in this regard is through the deliberations of a coordinating committee, which is the subject of the first suggested program. In fact, the recommendation for programs designed to promote appropriate infrastructural development are:

1. The coordination of infrastructure and services planning.

2. Obtaining consensus agreement of landowners on the easement or right-of-way over private property for the installation and maintenance of essential services.

3. Design of an Energy Management Plan.

4. Development of a stormwater collection and disposal system that minimises erosion and maximises the recycling of water for irrigation.

5. Establishment of an integrated water conservation program.

PROGRAM 11.1 COORDINATION OF INFRASTRUCTURE AND SERVICES PLANNING

Agencies Responsible: IDI, NPC, MWCS, NIC

Potential Funding Sources: Government finances, local government rates and Taxes (?)

Potential Sources of Expertise: NPC, MWCS, NIC

Nature of Program: The coordination of planning for the delivery of services to residential and other areas is critical to all future environmentally sustainable development of land in Nauru. Once the necessary planning policy and legislation is in place for access to private property, implementation can be managed by local government and the relevant Government ministries, in accordance with government policy and the relevant responsibilities of each institution.

For example, efficiencies in installation can be achieved by the use of common trenching for services such as power and telecommunications, or stormwater and sewers (both of which are essentially gravity systems). Construction costs can be lessened by utilising a single contractor to install all services, and to coordinate with other earthworks and road-building tasks. Services that can be planned together in this way include water supply, telecommunications, power supply, stormwater, sewer, reticulated gas, street lighting, and road construction.

PROGRAM 11.2 CONSENSUS AGREEMENT ON EASEMENT OR RIGHT-OF-WAY FOR ESSENTIAL SERVICES

Agencies Responsible: Cabinet, IDI, NPC, MWCS, NIC

Potential Funding Sources: Government Finances

Potential Sources of Expertise: NPC, MWCS, NIC, Department of Survey and Land Title Register

Nature of Program: In order to be able to plan for the efficient supply of services in Nauru, planners need to be able to design layouts of pipes and conduits through private land. In most cases, it may not be necessary, nor even desirable, for land to be compulsorily acquired for this purpose. However, it is essential that Nauruans understand the advantages for their land, of being serviced in this way. For major trunk routes of services that do need regular maintenance, acquisition of land may be the best option.

The doctrine of "the common good" should be proposed as a reason to allow access easements for the proper authorities on private property for the provision of essential services. This result should be reached by consensus, however, rather than by decree, and may need to be preceded by an educational program that explains the various options, and the benefits that will be achieved. People will be more likely to agree if they understand that the result will make it much easier to build new houses on their land, the demand for which is quite strong.

PROGRAM 11.3 ENERGY MANAGEMENT PLAN

Agencies Responsible: IDI, NPC, MWCS, NIC

Potential Funding Sources: Government Finances, Forum Secretariat Energy Unit

Potential Sources of Expertise: The existing Energy Committee, IDI, NPC, MWCS, NIC

Nature of Program: The cost of energy in the form of electrical power and petroleum is a major drain on the finances of all Pacific Islands. Small markets and large transport distances mean that unit costs are high compared with continental countries and those countries that produce their own fossil fuels. Given the deterioration in terms of trade, it is an important issue for Nauru to initiate an Energy Management Plan that considers the following factors:

1. The dependence on and increasing cost of imported fuel relative to export earnings.

2. The potential for financial and environmental benefits accruing from an active energy conservation program. A policy of obtaining full cost recovery of energy purchased by the public provides a great incentive for energy savings. Public awareness campaigns will be essential for this purpose.

3. The potential of reforestation and management of forests for the supply of cooking fuel as an alternative to imported fuels, and the use of efficient wood-burning stoves. Initially this could provide firewood for barbecues and cooking for special occasions in the traditional earthen oven.

4. The potential for solar, wind, wave and possibly other kinds of renewable energy sources that again replace imported fuels. This could initially focus on the promotion of solar water heaters.

5. Provision of support for negotiations for more equitable regional prices for fossil fuels.

6. The potential for incorporation of energy-saving design features in all new buildings, and energy management systems for commercial complexes.

PROGRAM 11.4 INTEGRATED WATER CONSERVATION AND SUPPLY MANAGEMENT

Agencies Responsible: IDI, NPC, MWCS, NIC

Potential Funding Sources: Government Finances, Local Government Rates and Taxes (?), AusAID

Potential Sources of Expertise: NPC, MWCS, NIC

Nature of Program: Nauru is situated in the dry equatorial climatic region. Water supply is constrained by extremely variable rainfall and regular prolonged droughts. The porous nature of the soil makes surface storage very difficult. Groundwater resources have been mapped, but are limited. The population is highly urbanised and has a relatively high rate of water usage. All these factors underline the importance of developing an integrated water conservation and supply management strategy for both residential and commercial/industrial sites, including the design of a water supply system that uses both desalination and rainwater storage as complementary strategies. Again, this will make the provision of water as cost-effective and efficient as possible. This strategy should consider at least the following factors:

1. The conservation and protection of freshwater resources in the form of Buada Lagoon and the groundwater lens are discussed in the NACRDFS. Salt-water incursion, over use (overdraught on the freshwater lens) and pollution by human activities are the greatest threats to maintaining water quality. A recent excavation was observed on bottomside that has opened up a gallery in the groundwater. This gallery is intended for milkfish production, but also provides an enormous opportunity for contamination of the resource, and a potential hazard to young children. The environmental risks associated with such developments should be thoroughly investigated.

2. Planning for the on-going maintenance and operation of the desalination plant and it's cost-effectiveness with respect to the source of heat energy.

3. Incorporation of rainwater tanks and catchment systems into the building code for all new structures.

4. Pollution of wells by livestock, septic tank systems and other pollution sources, and possible alternatives (see also above).

5. Full cost-recovery of water delivered by truck and projections of the delivery capacity for the future population growth.

6. Possibility of accessing overseas aid or soft loans for development of water supply systems.

7. Promotion of water conservation awareness as for energy above.

8. Planning of water supply services for newly developed areas on Topside, including the possibility of developing rainwater catchment systems and reservoirs.

PROGRAM 11.5 DEVELOPMENT OF STORMWATER COLLECTION AND DISPOSAL SYSTEM FOR RE-USE

Agencies Responsible: IDI, NPC, MWCS, NIC

Potential Funding Sources: Government Finances, Local Government Rates and Taxes (?)

Potential Sources of Expertise: NPC, MWCS, NIC

Nature of Program: A strategy to determine the most efficient way of maximising the collection and use of stormwater, and its creative disposal where it cannot be collected, would underpin a national strategy for water conservation and reduce reliance on the energy-intensive desalination system.

OBJECTIVE 12: ADDRESSING AND PREPARATION FOR GLOBAL CLIMATE CHANGE AND SEA-LEVEL RISE

The extent of future sea-level rise in Nauru is unknown. There are, however, a number of programs that are suggested to address its possible effects. These include:

1. Continuing strong commitment to international initiatives addressing global climate change and sea-level rise,

2. Development of an Integrated Coastal Zone Management and Coastal Protection Plan,

3. Coastal forest protection and reforestation, and

4. Protection from ultraviolet radiation.

PROGRAM 12.1 STRONG COMMITMENT TO INTERNATIONAL INITIATIVES ADDRESSING GLOBAL CLIMATE CHANGE

Agencies Responsible: Office of the President, IDI, Ministry of Justice and Nauru NGOs.

Potential Funding Sources: SPREP, SOPAC, Forum Secretariat, Government Finances.

Potential Sources of Expertise: SPREP, USP, SOPAC, Forum Secretariat, SPC, Greenpeace and appropriate overseas agencies.

Nature of Program: Nauru' has shown very strong support for initiatives to address the issue of global climate change. It is imperative that this interest and involvement continues if Nauru is to receive maximum benefit from the information, technical expertise, training opportunities and funding available through such programs.

Nauru continues to be an active participant in the SPREP South Pacific Sea Level and Climate Monitoring Project, it has hosted one of the Project's annual meetings, and currently has a Sea Level and Climate Monitoring Station located in the main boat harbour in Aiwo.

In terms of addressing the problem of the depletion of the earth's protective ozone layer, Nauru must continue to support the Montreal Protocol banning CFCs and any other actions that can minimise the breakdown of the ozone layer.

Nauru is currently in the process of finalising plans to become an active participant in the U.S. Department of Energy's Atmospheric Radiation Measurement (ARM) Program designed to gather data on cloud and radiation feedback effects over the Tropical Western Pacific as a basis for predicting the time and magnitude of greenhouse gas-induced global warming and its effects. As part of the ARM Program, Nauru has been selected as one of the sites for an Atmospheric Radiation and Cloud Station (ARCS), one of a number of such stations extending from Indonesia and Manus Island in Papua New Guinea to Kiritimati Island in Kiribati.

PROGRAM 12.2 INTEGRATED COASTAL ZONE MANAGEMENT AND COASTAL PROTECTION

Agencies Responsible: IDI, MWCS, NIC, Ministry of Justice and Nauru NGOs.

Potential Funding Sources: SPREP, SOPAC, AusAID, Government Finances.

Potential Sources of Expertise: SPREP, USP, SOPAC, SPC, Greenpeace and appropriate overseas agencies.

Nature of Program: Nauru's existing problems of coastal erosion and damage to vegetation, reefs, seawalls, other structures and property due to extreme events, such as storms, tidal waves, high tides and saltspray, will be magnified if predicted rises in sea-level occur. **It is recommended that Nauru continue to work with local, regional and international organisations to develop a National Integrated Coastal Zone Management (ICZM) and Coastal Protection Plan to minimise the negative impacts of sea-level rise and extreme events.**

Tn this respect Nauru has participated in all of the SPREP-SOPAC Coastal Protection Meetings and has a Special Projects Officer in charge of Coastal Protection located in IDI.

Important components of this program should include:

1. Gathering of data on Nauru's coastal systems and processes as a basis for better planning of the development, siting and design of coastal structures. Some preliminary work was done in this area with the help of expertise from the Cook Islands (Cain 1994).

2. The development of an Integrated Coastal Zone Management (ICZM) Plan which rationalises the location of major developments and structures based on both the needs of the community and the natural attributes and hazards associated with different coastal sites and environments.

3. An education and public awareness program about coastal problems and the need for ICZM and coastal protection.

4. An active program to protect existing coastal forests and vegetation and to initiate programs for coastal reforestation (although seen as integral to ICZM, this is listed as a separate Program 12.3 below).

5. A program to develop the most appropriate coastal engineering practices (e.g., sea walls, revetments, boats channels, etc.) that will minimise risks of environmental degradation and economic loss due to existing coastal processes which will be intensified if sea level rises.

PROGRAM 12.3 COASTAL FOREST PROTECTION AND REFORESTATION

Agencies Responsible: IDI, NRA, NIC, and Nauru NGOs.

Potential Funding Sources: SPREP, SPFDP, SOPAC, AusAID, Government Finances.

Potential Sources of Expertise: SPREP, USP, SPFDP, Forestry Division (Tonga) and appropriate overseas agencies.

Nature of Program: Because of the critical role that coastal trees play in coastal protection, **it is recommended that a Coastal Forest Protection and Reforestation Program be commenced immediately.**

A pilot program has been successfully carried out in Tonga using almost exclusively indigenous salt-tolerant coastal tree species (Thaman *et al*. 1995a), and Nauru is currently working with the South Pacific Forestry Development Program to develop a similar program. The Nauru Environment Association has since 1994 had a program to plant coconut palms and a number of other species along roads and coastal frontages.

Such a program should include the following components:

1. A program to immediately protect all coastal and littoral trees and plant species (e.g., **irin, ini, epo, itirya, yetsiu, emed, iyo, kwenababai**, and **erekogo**) because experiences have shown that it is **far** easier to protect existing trees than it is to replant coastal trees.

2. Selection of appropriate species for propagation and outplanting (Information on potential species for coastal reforestation in Nauru are listed in Appendices 6 and 7).

3. Selection of a nursery/plant propagation site where plants can be propagated, transplanted to, and prepared for outplanting to coastal sites (the nursery could be combined with the nurseries suggested under Programs 4.6 and 4.7 above, or with the NIC Nursery on Topside, to achieve economies of scale).

4. Identification of relatively undisturbed coastal and inland sites that can serve as sources of planting materials (e.g., seeds, self-sown seedlings, cuttings, etc.) that can be propagated or matured in the nursery in preparation for transplanting to priority coastal sites.

5. Conduct of an in-country training program for the propagation, transplanting, and nursery and field maintenance and protection of coastal species (This could also include a visit to Tonga to work with Tokomololo Forestry Division Nursery staff that have been responsible for the coastal reforestation project there).

6. Conduct of a public awareness campaign on the importance of the protection and replanting of coastal forests and trees as protection against coastal erosion, loss of property and other negative effects of sea-level rise. The campaign should also stress the cultural and economic importance of indigenous cultural species and why they should be protected and replanted as part of the cultural heritage of Nauru.

PROGRAM 12.4 PROTECTION FROM ULTRAVIOLET RADIATION

Agencies Responsible: IDI, MWCS, NIC, MOE, Churches, Women's Organisations, NEA and other Nauru NGO.

Potential Funding Sources: SPREP, SOPAC, ARM Program, Government Finances.

Potential Sources of Expertise: ARM Program, SPREP, USP, SPC, Greenpeace and appropriate overseas agencies.

Nature of Program: Given the very serious known affects or increasing levels of ultraviolet radiation on living things, especially its role in causing cancers and weakening the human immune system (and the fact that the depletion of the ozone layer will continue into the next century), **it is recommended that Nauru take immediate steps to protect it inhabitants from overexposure to sunlight and increasing ultraviolet radiation**. This will require:

1. The immediate protection and planting of forests and shade trees which provide protection to both humans and other plants and animals from increasing ultraviolet radiation (this would include the planting of shade trees in all appropriate locations).

2. An intensive public education program about the dangers of overexposure to sun due to the breakdown in the Earth's ozone layer and stressing the need to modify activities to minimise exposure to the sun in the middle of the day.

3. The encouragement of the use of sunscreens, appropriate sunglasses and clothing, particularly by children, fishers (fishermen and fisherwomen) and other outdoor workers who spend long periods in the sun and who will be effected worse by increasing ultraviolet light levels in the future (there are a number of companies in Australia that now produce clothing that gives greater protection from ultraviolet light than conventional clothing).

4. Make provision in housing plans and the development of residential, civic and recreational areas for increased shade and protection from the sun (e.g., provision of protected bleachers or shade trees around tennis courts, football ovals, running tracks, etc.).

OBJECTIVE 13: MAINTENANCE OF A STRONG ANTI-NUCLEAR STANCE

Given the long-term irreversible environmental and human health damage that results from the use of nuclear technology in the Pacific, the maintenance of Nauru's strong anti-nuclear stance is a priority. This should include

1. A continued commitment to all international anti-nuclear initiatives and

2. The initiation of a local nuclear awareness campaign.

PROGRAM 13.1 CONTINUED STRONG COMMITMENT TO ALL INTERNATIONAL ANTI-NUCLEAR INITIATIVES

Agencies Responsible: Office of the President, IDI, Ministry of Justice and Nauru NGOs.

Potential Funding Sources: SPREP, Forum Secretariat, Greenpeace, Government Finances.

Potential Sources of Expertise: SPREP, Forum Secretariat, Greenpeace, USP and appropriate overseas agencies.

Nature of Program: As stressed above, the most important activity to address the nuclear issue is to maintain Nauru's strong commitment to all international and regional anti-nuclear initiatives.

Nauru is already signatory to: 1) the Treaty on the Non-Proliferation of Nuclear Weapons (NPT)(1970); 2) the South Pacific Nuclear Free Zone Treaty, Rarotonga (1985); 3) the Convention on the Prohibition of Chemical Weapons; and, 4) the Convention to Ban the Importation into Forum Island Countries of Hazardous and Radioactive Wastes and to control the Transboundary Movement and Management of Hazardous Wastes within the South Pacific Region, Waigani, Port Moresby (1995). All of these international treaties and protocols are probably the best means of ensuring regional and international solidarity in terms of realising the goal of a "Nuclear-Free Pacific".

Nauru continued its high profile stance in 1995 when it led a Pacific Islands protest against the continuance of French Nuclear weapons testing by suspending diplomatic relations with France and boycotting the recent South Pacific Games in Tahiti. In the future Nauru will maintain its unwavering stance against nuclear activities in the Pacific region and provide its unconditional support to efforts by the United Nations Conference on Disarmament (UNCD) in Geneva to finalise a Comprehensive Test Ban Treaty (CTBT) to end nuclear testing forever. A verifiable and enforceable CTBT would:

1. Pave the way for nuclear disarmament and the prohibition of the perfecting of new weapons;

2. Reduce risks to human health and the Pacific environment due to testing, leakages of nuclear materials or nuclear accidents; and,

3. Help stop nuclear proliferation and make it more difficult for non-nuclear states to develop nuclear arsenals (Greenpeace 1995).

PROGRAM 13.2 NUCLEAR AWARENESS AND EDUCATION CAMPAIGN

Agencies Responsible: IDI, Ministry of Education, NIC Ministry of Justice, Churches, Women's Organisations, NEA and other Nauru NGO.

Potential Funding Sources: SPREP, Greenpeace, other international NGOs, Government Finances.

Potential Sources of Expertise: SPREP, Greenpeace, USP and appropriate overseas agencies.

Nature of Program: In order to improve local understanding of the nuclear issue and why the Government and other Pacific countries have taken such a strong stance on the issue **it is recommended that a Nuclear Awareness and Education Campaign be commenced**. This should include:

1. A general public awareness campaign to increase understanding of the history of nuclear pollution and impacts on human health of nuclear weapons testing and other nuclear activities in the Pacific, and,

2. A inclusion of a week-long unit on nuclear radiation and the nuclear issue in the Social Science and Science curricula, at the senior high school level in the formal education system.

To implement this program, Nauru should take advantage of the excellent educational materials produced by Greenpeace and other organisations. These materials are readily available, easy-to-understand and are usually provided free-of-charge. They can also be easily copied for distribution to the public, adapted for use by the media or used directly as student and teaching resource materials for schools.

OBJECTIVE 14: MAINTENANCE OF A STRONG STANCE AGAINST TRADE IN TOXIC AND HAZARDOUS WASTES

Given the serious danger to the health of Pacific peoples and the environment by toxic and hazardous wastes, **it is recommended that Nauru maintain a strong stance against trade and disposal of toxic and hazardous wastes in the Pacific Islands**. The main strategy recommended to deal with the unethical, often illegal and extremely environmentally dangerous trade in toxic and hazardous wastes is, as suggested in Program 13.1, for Nauru to maintain its continued strong for support all regional and international initiatives, like the Waigani Convention to ban the trade of toxic wastes.

PROGRAM 14.1 SUPPORT OF REGIONAL INITIATIVES TO BAN THE IMPORTATION OF HAZARDOUS AND RADIOACTIVE WASTES

Agencies Responsible: Office of the President, IDI, Ministry of Justice, Churches, Women's Organisations, NEA and other Nauru NGOs.

Potential Funding Sources: SPREP, Forum Secretariat, Greenpeace, Government Finances.

Potential Sources of Expertise: SPREP, USP, SOPAC, Forum Secretariat, Greenpeace and appropriate overseas agencies.

Nature of Program: To address the serious issue of trade in toxic and hazardous wastes and their disposal in the Pacific Island environment **it is recommended that Nauru maintain its strong stance against such activities and continue to support all regional and international initiatives to ban the importation and disposal of such wastes in the Pacific Islands.** Most importantly is Nauru's strong support and adherence to the Convention to Ban the Importation into Forum Island Countries of Hazardous and Radioactive Wastes and to control the Transboundary Movement and Management of Hazardous Wastes within the South Pacific Region (the Waigani Convention, Port Moresby, 1995).

It is also important for Nauru to carefully analyse the lists of hazardous substances listed in the Annexes of the Convention and to promote the safe disposal of any of these wastes or substance that already exist in Nauru (South Pacific Forum Secretariat, 1995).

CHAPTER 6

SUMMARY AND CONCLUSIONS

As stressed in the Forward, for three thousand years, Nauruans lived a relatively sustainable lifestyle in harmony with our land and sea. Over the past century, however, Nauru has been called upon to produce more than could be sustained and more than our island environment could endure. This has led to serious breakdown in our island environment and the physical and spiritual health of our people. If this trend is not reversed, Nauru and the Nauruan people will not survive into the 21st century and beyond. The purpose of this National Environmental Management Strategy (NEMS) and its National Environmental Action Plan (NEAP) is to provide guidelines and programs for returning to a more environmentally and culturally sustainable way of life.

The NEMS is not a map for a return to the days of subsistence, but a blueprint for sustainable development that will ensure that Nauruans continue to have access to goods and services of urban-industrial societies that can make life safer, healthier and more enjoyable, while **at the same time** protecting our island environment and cultural traditions as the capital needed for the development and maintenance of future generations. The NEMS is an attempt to identify ways of achieving a balance between traditional island life and a Western urban lifestyle.

The information on the physical, biological and cultural environment of Nauru constitutes a "State of the Environment Report" for Nauru. This information can serve as a basis for policy formulation and prioritisation and the identification of types of information that still need to be gathered or updated. This information also constitutes a body of knowledge that can be used by planners, politicians, educators, NGOs and other appropriate agencies or individuals a basis for decision making, briefings and the production of official papers and educational materials. The information on the status of current environmental institutions and legislation provides a basis for analysing those areas that need strengthening if environmental considerations are to become an integral part of the development planning process in Nauru.

The section on environmental constraints and challenges examines the major issues and constraints to environmentally sustainable development in Nauru that were identified during the NEMS consultations in 1995 and 1996. These range from local issues such as land degradation and the need for rehabilitation, which is foremost on the minds of most Nauruans, to international issues such a global climate change, sea-level rise, nuclear pollution and trade in hazardous wastes, issues to which Nauru has given its unwavering support. Other important issues that must be addressed include inadequate environmental education, including loss of traditional environmental knowledge, inadequate environmental infrastructure and legislation, loss of biodiversity, coral reef and marine resource degradation and overexploitation, pest and disease infestations, pollution and waste management, population growth and urbanization, health and nutritional deterioration, economic vulnerability and instability, and inadequate development infrastructure and services. All of these constitute constraints to our pursuit of environmentally and culturally sustainable development in Nauru.

The most important part of the NEMS is the National Environmental Action Plan (NEAP). The NEAP consists of a wide range of Objectives and individual Programs that can be implemented to promote sustainable development. The programs and activities are not prioritised in order of importance, although some, such as the rehabilitation of the mined-out areas of Nauru, the strengthening of environmental awareness and education, the strengthening of environmental infrastructure and legislation, the protection of endangered terrestrial and marine resources, waste management and pollution control, population planning and the identification of sustainable economic alternative to phosphate mining, are all seen as essential to the promotion of environmentally sustainable development on Nauru.

While some programs and activities will require outside funding and expertise, some can be implemented immediately by government or by local communities, landowners or individual citizens. For each program, an attempt has been made to identify the agencies that might be responsible for implementation, potential funding sources, sources of expertise and to outline the nature of program. The rehabilitation of the mined areas will, of course, depend heavily on the Nauru Rehabilitation Funds, the establishment of the Nauru Rehabilitation Authority and the initiation of rehabilitation activities suggested by the Nauru Australian Cooperative Rehabilitation and Development Feasibility Study (NACRDFS).

As stressed in the introduction, our beautiful, productive island of Nauru was bequeathed to us by God, our Heavenly Father. It our is duty to Him and to His children on Nauru to care for and rebuild this priceless gift so that we can live a harmonious sustainable Christian existence forever and ever under His merciful guidance. This National Environmental Management Strategy (NEMS) and the National Environmental Action Plan (NEAP), together with the NACRDFS, constitute a basis for the launching of a new era of environmental awareness and the promotion of environmentally and culturally sustainable development for the long term benefit of all Nauruans, our God-given island home and its plants, animals, reefs, lagoons and sea. By this document, the government and people commit themselves to the task of rehabilitation and stewardship of our God-given island of Nauru and to the implementation of the programs included in both the NEMS and the NACRDFS.

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Appendix 3. Plant species indigenous or possibly indigenous to Nauru (? = status uncertain, possibly an aboriginal or recent introduction; E = possibly extinct; e = endangered or rare).

Type/Species (Nauru Name)	Status
PTERIDOPHYTES	
Asplenium nidus	+e?
Nephrolepis biserrata (dakeang)	+
Nephrolepis hirsutula	+
Ophioglossum petiolatum	+
Phymatosorus scolopendria (dakeang)	+
Psilotum nudum (ibiribir)	+
Pteris tripartita	+
Subtotal	7
HERBS	
Achyranthes canescens	E?
Boerhavia repens	+e
Heliotropium procumbens	+e
Laportea ruderalis	+e
Triumfetta procumbens (ikiow)	+
Subtotal	4 (1E)
GRASSES AND SEDGES	
Mariscus javanicus (reyenbangabanga)	+?
Digitaria setigera	+?
Fimbristylis cymosa	+
Lepturus repens	+
Stenotaphrum micranthrum	+e
Subtotal	5
VINES AND LIANAS	
Canavalia cathartica (erekogo)	+e
Canavalia rosea (erekogo)	+e
Capparis quiniflora	+e
Cassytha filiformis (denuwanini)	+
Derris trifoliata	+e

Ipomoea littoralis (erekogo)	+e
Ipomoea macrantha (erekogo)	+
Ipomoea pes-caprae (erekogo)	+
Vigna marina (erekogo)	+
Subtotal	9

SHRUBS

Abutilon asiaticum var. *albescens* (ekaura)	+e
Caesalpinia bonduc (dogiane)	+e
Capparis cordifolia (ekabobwiya)	+
Clerodendrum inerme (eyamwiye)	+
Colubrina asiatica (ewongup)	+
Dodonaea viscosa (eteweau)	+
Euphorbia chamissonis	+e
Phyllanthus societatis (ewemangemang)	+
Scaevola taccada (emet)	+
Sida fallax (idibin kaura)	+e
Suriana maritima	+e
Subtotal	11

TREES

Aidia cochinchinensis (ekwanimwi)	+e
Barringtonia asiatica (kwenababai)	+e
Bruguiera gymnorrhiza (etum, etam)	+e
Calophyllum inophyllum (iyo)	+
Cerbera manghas (dereyongo)	+e
Cocos nucifera (ini)	+?
Cordia subcordata (eowongo)	+e
Erythrina variegata (yoreh)	+e
Fagraea berteriana	E?
Ficus prolixa (eyayo)	+
Guettarda speciosa (yut)	+
Hernandia nymphaeifolia (etsiu, yetiu)	+e
Hibiscus tiliaceus (ekwane)	+
Morinda citrifolia (deneno)	+
Ochrosia elliptica (eorara)	+e
Neisosperma oppositifolium (?)	+e
Pandanus tectorius (epo, epuh)	+
Pisonia grandis (yangys, yangits)	+e
Premna serratifolia (idibinerr)	+
Rhizophora apiculata (dadongo)	+e

Tarenna sambucina	E?
Terminalia catappa (etetah)	+?
Thespesia populnea (itirya)	+e
Tournefortia argentea (irin)	+
Vitex negundo (dagaidu)	+e
Subtotal	23 (2E)
TOTAL SPECIES	59 (3E)

Sources: An extensive review of the available literature and personal records and observations by the authors; see in particular Thaman 1992; Manner, Thaman and Hassall 1984, 1985; Thaman *et al*. 1994.

Appendix 4. Indigenous bird species reported present in Nauru (In terms of "Status", R = resident all year, but not necessarily breeding; M = migratory breeder, which breeds at the locality, but departs for the rest of the year; V = includes passage migrants as well as vagrants; W = winter resident; resident during the non-breeding season, from the bird's perspective, e.g. some species visit during the austral winter and some during the northern hemisphere winter; E = endemic; ? = unconfirmed record).

Common Name	Latin Name	Status
Audubon's shearwater	*Puffinus lherminieri*	V
white-tailed tropic bird	*Phaethon lepturus*	R
red-tailed tropic bird	*Phaethon rubricauda*	V
brown booby	*Sula leucogaster*	V
great frigatebird	*Fregata minor*	V
Pacific reef heron	*Egretta sacra*	R
gray/black-bellied plover	*Pluvialis squatarola*	V
lesser golden plover	*Pluvialis dominica*	W
Mongolian plover	*Charadrius mongolus*	V
great sand plover	*Charadrius leschenaultii*	V
wandering tattler	*Heteroscelus incanus*	W
Siberian/gray tailed tattler	*Heteroscelus brevipes*	W
whimbrel	*Numenius phaeopus*	V
bar-tailed godwit	*Limosa lapponica*	W
ruddy turnstone	*Arenaria interpres*	W
sharp-tailed sandpiper	*Calidris acuminata*	V
black-naped tern	*Sterna sumatrana*	R
sooty tern	*Sterna fuscata*	R
brown noddy	*Anous stolidus*	R
black noddy	*Anous minutus*	R
common fairy tern	*Gygis alba*	R
Micronesian pigeon	*Ducula oceanica*	R
long-tailed cuckoo	*Eudynamis taitensis*	W
sacred kingfisher	*Halcyon sancta*	?
Nauru reed wharbler, Nauru canary	*Acrocephalus rehsei*	R(E)

Sources: Adapted from Pratt et al., 1987.; Pearson, A.J. 1962. Field notes on the birds of Ocean Island and Nauru during 1961. *Ibis* 104:421-424.

Appendix 5. Nauruan, common and scientific (Latin) names of some finfishes reported present in Nauru.

Nauruan	Common Name	Latin Name
apwe	dusky jack	*Caranx sexfasciatus*
apwe	black jack	*Caranx lugubris*
debagommaroa	long-tail ray	*Himantura* sp.
degabouwa	great barracuda	*Sphyraena barracuda*
degoriria	tawny shark	*Ginglymostoma ferrugineum*
degomat	black-spotted boxfish	*Ostracion cubicus*
deiboe	surgeonfish	*Acanthurus mata*
deiboe	yellowfin surgeonfish	*Acanthurus xanthopterus*
dereba	yellow-spotted surgeon-fish	*Acanthurus aliala*
dereba	red-spotted surgeonfish	*Acanthurus* sp.
dorangarang	yellowstripe goatfish	*Mulloides flavolineatus*
doruwa	lowly trevally	*Caranx ignobilis*
eabangingab	long-jawed squirrelfish	*Sargocentron spiniferum*
eae	skipjack tuna	*Katsuwonus pelamis*
eaeo	Gilbert's cravelly	*Carangoides gilberti*
eaeo	yellow-spotted trevally	*Carangoides orthogrammus*
eaeo	golden trevally	*Gnathanodon speciosus*
eaeokwor	oilfish	*Ruvettus pretiosis*
eaiar	silvery mullet	*Neomyxus chaptalli*
eanape	orange rock-cod	*Epinephelus truncatis*
eanape	freckled rock-cod	*Cephalopholis coatesi*
eanurum, irum	red snapper, two-spot red snapper	*Lutjanus bohar*
eaor	sea mullet	*Mugil cephalus*
eaor	bluetail/bluespot mullet	*Valamugil seheli*
eaouna	yellowlip emperor	*Lethrinus xanthochilus*
earamai	blue-fronted parrotfish	*Callyodon cyanognathos*
earata?	scribbled leatherjacket	*Aluterus scriptus*
earata	yellow and blue seaperch	*Lutjanus kasmira*
earata	blue-lined snapper	*Lutjanus quinquelineatus*
earo	black-tipped grouper	*Epinephelus fasciatus*
eaurur	black-spotted grouper	*Epinephelus macrospilos*
eaywiwi	dolphin fish, mahimahi	*Coryphaena hippurus*
ebawo	ashen drummer	*Kyphosus cinerascens*
ebawo kumo	white-tipped shark	*Triaenodon apicalis*
ebo	white-tailed sqirrel-fish	*Adioryx audimaculatus*
ebo	blue-lined squirrelfish	*Sargocentron tiere*
edowedowa	mackerel tuna	*Ethynnus affinis*

dorangaran

egow	wahoo	*Acanthocybium solandri*
egop	hammerhead shark	*Sphyrna lewini*
egarokoa	silver squirrelfish	*Holocentrus microstomus*
eimar	black-tipped shark	*Carcharhinus longimanus*
ekadawea	barred garfish	*Hemirhamphus far*
ekadawea	longbill garfish	*Rynchorhampus georgi*
ekiakuo	yellow-tail mullet	*Liza vaigiensis*
ema	smooth flutemouth	*Fistularia petimba*
emorr	flying fish	*Cheilopogon* spp.
emorr	flying fish	*Cypselurus simus*
emorr	flying fish	*Cypselurus* spp.
emwan	big-eye squirrelfish	*Myripristis amaenus*
emwan	big-scale soldierfish	*Myripristis berndti*
emwan	violet squirrelfish	*Holocentrus violaceus*
emwan	fleshy squirrelfish	*Holotrachys lima*
eokong	rabbit-faced spinefoot	*Siganus rostratus*
eokwoy	rainbow runner	*Elegatis bipinnulatis*
erenai	lunar-tailed cod	*Variola louti*
etaro	dark-finned barracuda	*Sphyraena genie*
etom	peacock rock-cod	*Cephalopolis argus*
eweo	convict surgeonfish	*Acanthurus triostegus*
eyongco	scorpion cod	*Pterois antennata*
iamit (yamit)	moray eels	*Gymnothorax* spp.
ianen	black-tipped rock cod	*Epinephelus fasciatus*
ianit	coral cod	*Cephalopholis miniatus*
ianit	rock cod	Serranidae
ibiya	milkfish	*Chanos chanos*
iyubur	shortbill spearfish	*Tetraptulus brevirostris*
iebo	Port Fraslin squirrel-fish	*Myripristis pralinius*
ierangue	black-tipped shark	*Carcharhinus spallanzi*
ieru	snake mackerel	*Gempylus serpens*
ikuri	mackerel scad	*Decapterus pinnulatis*
ikuri	round scad	*Decapterus macrosoma*
iniame	red-tail snapper	*Lutjanus fulvus*
iniame	black-spot sea-perch	*Lutjanus viflamma*
iniame tebo, agen tebo	humpback red snapper, paddltail	*Lutjanus gibbus*
ipwo	leatherjacket	*Cantherhines dumerili*
iquri	bigeye scad	*Selar crumenophthalmus*
irer	orangespine unicornfish	*Naso lituratus*
iriname	sailfish (pink)	*Istiophorus ius*
iriname?	sailfish	*Istiophorus platypterus*
itsibab	albacore tuna	*Thunnus alalunga*
itsibab	yellowfin tuna	*Thunnus albacares*
itsibab	bigeye tuna	*Thunnus obesus*
itsibab	dogtooth tuna	*Gymnosarda unicolor*

ituwabu	onespot snapper	*Lutjanus monostigma*
iubur	black marlin	*Istiompax (Makaira) indicus*
iubwiya	striped bristletooth surgeonfish	*Ctenochaetus striatus*
iudud	hawkfish	*Cirhites pinnulatis*
iuiuj	long tom, choram longtom	*Tylosurus crocodilus*
iwiji	blue-lined surgeonfish	*Acanthurus lineatus*
iwuro	white-lined rockcod	*Anyperodon leucogrammicus*
iwuro	orange rock-cod	*Epinephelus hexagonatus*
iwuro	rock-cod	*Epinephelus melanostigma*
iwuro	honeycomb rock cod	*Epinephelus merra*
iwuro	greasy cod	*Epinephelus tauvina*
iyibawo	topsail drummer	*Kyphosus cinerascens*
kawudo	marbled rock-cod	*Epinephelus microdon*
kawudo	red-spotted coral cod	*Plectropomus leopardus*
kimago	blue-banded angelfish	*Pygoplites diacanthus*
kiyoyo	long-horned unicornfish	*Naso herrei*
kumum	green triggerfish	*Pseudobalistes flavimarginatus*
kwidada	bluefin trevally	*Caranx melampygus*
ngope	reef stonefish	*Synanceja verrucosa*
ngope	weedy stingfish	*Scorpaenopsis cirrhosus*
tareb	red jobfish	*Aphareus rutilans*
yab ereber	surf surgeonfish, spotted surgeonfish	*Acanthurus guttatus*

Source: Fisheries Division, Department of Island Development and Industry (IDI) records.

Appendix 6. Information on tree and other plant species that could be the main focus of a "Forestry and Agroforestry Development Program" for Nauru.

***Cocos nucifera* (coconut):** Thaman *et al*. (1985) listed five named Nauruan coconut varieties, indicating that there were at least that number of known varieties. Studies in Kiribati and Tonga have shown plantation densities of up to 231 and 157 trees per hectare respectively, in agroforestry situations. In Tarawa, production of nuts was about 23.1 nuts per tree per annum, and per capita consumption was 4 nuts per person per day, and 3 nuts per pig per day where they were the main source of feed. There is no doubt that coconuts will form a major part in any Nauruan agroforestry system, and these data help to plan the planting needs and densities of this valuable species. Studies by Thaman (1993) show that there are over 100 traditional uses for coconuts, many of which will be important for cultural and economic sustainability in the future. Consideration should also be given to planting special varieties for eating, drinking, weaving, construction and for making coir, especially if traditional crafts are revived, both for local consumption and for a limited tourism industry.

***Pandanus tectorius* (pandanus):** Seventeen Nauruan pandanus varieties were listed by Thaman et al. (1985), indicating the traditional importance of this species. Varieties were recognized based on their particular usage, which may have been for food or handicraft. A mature pandanus can cover up to 40 square metres, but a survey of a planted grove in 1982 by some Nauruan High School students showed a density of 21 trees in an area of 1500 square metres. Unfortunately, this grove has now been cleared prior to mining. It is not known how many of the original varieties are still in existence, but it is a matter of urgency to locate, catalogue and propagate the best of the remaining varieties. Because pandanus planted from seed will rarely reproduce desirable characteristics, propagation has to be from cuttings, ideally cuttings with the beginnings of adventitious roots. There may be some scope, however, for either the experimentation with some planting from seed, or for the re-introduction of some varieties from Banaba (Ocean Island) or Kiribati.

***Artocarpus altilis* (breadfruit):** A number of different varieties of breadfruit are present and performing well in Nauru. This is one of the most economically and nutritionally important trees in the Pacific islands, and could be an important staple crop for Nauru. It is also a very attractive species for home gardens. In Kiribati over four trees per household are commonly observed, and in Tonga, densities of 36 trees per hectare have been recorded. According to Thaman (1990), breadfruit trees are almost always planted in holes or circular well-like structures. These are filled with green waste, including the dead leaves of coconuts and breadfruit, and the leaves of *Scaevola taccada*, *Tournefortia argentea*, *Guettarda speciosa* and *Morinda citrifolia* (**emet, irin, yut** and **deneno**), all species present in Nauru. They are then commonly topped by black soil found under *G. speciosa*. Although breadfruit seems to have the limited resistance to prolonged drought, it does bear several crops of fruit a year. Propagation is by vegetative means.

***Mangifera indica* (mango):** Mangoes were once planted widely in Nauru, particularly in the remnant forest around Buada Lagoon, and on the Bottomside in Anabar and Anetan Districts. They occur now mainly as large, mature trees, many of which display a tall and lanky habit. Few of them appear to be bearing any fruit, except during very dry periods. They are thought to be senescent. Very few seedlings were observed in the vicinity of the trees, and it is suggested that new stock of the most appropriate varieties be imported to replace the existing trees, as well as

being planted in newly developed agroforestry areas. Free-ranging pigs may also be the reason for non-survival of seedlings.

Other Cultivated Fruit Trees

Bananas and plantains (*Musa cultivars*) are commonly observed in Nauruan gardens, in houseyard gardens at Location settlement and in a number of locations near the Topside workshops and topsoil pile. The Republic of Taiwan experimental garden is currently trialling several varieties, some of which appear to be very successful in terms of productivity.

Pawpaws (papayas)(*Carica papaya*) are also grown very successfully and are promising for future cultivation on a more widespread basis. Both bananas and pawpaws need to be planted away from coconut trees, because of competition from roots, and in well-mulched situations.

The lime (*Citrus aurantifolia*) is also observed in gardens, especially in the Buada Lagoon area, although many trees appear to be neglected. The fruit is very popular and the species promising for incorporation into an agroforestry system. It is one of the few species that does well on atolls.

A number of other food plants that are important in other Pacific Island agroforestry systems and which have already shown to grow well in Nauru should be incorporated into agroforestry systems. These include the hibiscus spinach (known as **bele** in Fiji) (*Hibiscus manihot*), as a very nutritious green vegetable, and cassava (*Manihot esculenta*), a common root crop currently grown on the topsoil stockpiles and along roadsides on Topside and in a number of houseyard gardens.

Other successful species in the experimental garden of the Republic of Taiwan include eggplant, long beans, Chinese cabbage and a number of other tropical vegetable varieties. This garden seemed to be suffering somewhat from a lack of soil profile and irrigation system, but represents a successful attempt to demonstrate the benefits to Nauru of horticultural and agroforestry expertise. The benefits would soon become apparent if this garden were to be transplanted to the Buada Lagoon.

Adams, Adams, Willens and Willens (1978) listed the relative tolerance to salt of a number of crop species that had succeeded in dry areas of tropical Africa. Of the fruit crops, Date palm is the most tolerant, followed by fig, olive and cantaloupe. Of the vegetable crops, kale and spinach are most tolerant, and then tomato, broccoli, cabbage, bell pepper, cauliflower, lettuce and sweet corn. If brackish or saline water is to be used for irrigation, appropriate varieties of these species may be worth trialling.

Appendix 7. Inland forest or disturbed area (I), coastal littoral (L) and mangrove (M) species that should be protected or considered for replanting in Nauru as part of coastal and inland reforestation programs (* = non-indigenous to Nauru; K = Kiribati name for plants with no known Nauruan name).

HIGH PRIORITY (scarce or endangered)

dadongo (*Rhizophora apiculata*)(M)
ekaura, idibin kaura (*Sida fallax*)(I)
ekaura, inen kaura (*Abutilon asiaticum*)
ekwanimwi (*Aidia cochinchinensis*
eoongo (*Cordia subcordata*)(L,I)
etam (*Bruguiera gymnorrhiza*)(M)
irin (*Tournefortia argentea*)(L,I)
itirya (*Thespesia populnea*)(L,I,M)
kwenababai (*Barringtonia asiatica*)(L,I)
yangis, yangits (*Pisonia grandis*)(I)
yetiu (*Hernandia nymphaeifolia*)(L,I)
yoreh (*Erythrina variegata*)
? (*Neisosperma oppositifolium*)(I)
dereiyongo (*Cerbera manghas*)(L,I)
***te ukin** (K) (*Terminalia samoensis*)(L,I)

PRIORITY (Important, but not endangered)

***Christmas tree, tanenbaum** (*Casuarina equisetifolia*)
dagaidu (*Vitex negundo*)
deneno (*Morinda citrifolia*)(I,L)
ekwane (*Hibiscus tiliaceus*)(L,I)
emet (*Scaevola taccada*)(L,I)
eorara (*Ochrosia elliptica*)
epo, epuh (*Pandanus tectorius*)(L,I)
etetah (*Terminalia catappa*)(L,I)
eteweau (*Dodonaea viscosa*)(I)
idibinerr (*Premna serratifolia*)(I,L)
ini (*Cocos nucifera*)(L,I)
iut, yut (*Guettarda speciosa*)(L,I)
iyo (*Calophyllum inophyllum*)(L,I)

Appendix 8. Fruit, nut and multipurpose tree species or plants that could be protected and planted to maintain or strengthen household agroforestry in Nauru (* = non-indigenous; K = Kiribati name for plants with no known Nauruan name) Note: some of the primarily indigenous species listed in Appendix 8 should also be considered for planting in houseyard gardens and agroforestry development.

FRUIT AND NUT TREES

*bananas and plantains, **te banana** (*Musa* banana and plantain cultivars)
*bilimbi (*Averrhoa bilimbi*)
*bluggoe plantain, **dabanana** (*Musa* ABB Group "Bluggoe" plantain)
*breadfruit, **deme** (*Artocarpus altilis* and *A. mariannensis*)
*calamondin lime/orangequat (*Citrus mitis*)
*carambola (*Averrhoa carambola*)
coconut, **ini** (*Cocos nucifera*)
*common fig **te biku** (K)(*Ficus carica*)
*guava, **kuawa** (*Psidium guajava*)
*hibiscus spinach, **bele** (Fijian)(*Abelmoschus manihot*)
*horseradish tree (*Moringa oleifera*)
*ladyfinger banana, **dabanana** (*Musa* AAB Group "Pisang Raja" banana)
*lemon (*Citrus limon/hystrix*?)
lettuce tree, **yangis (***Pisonia grandis*)
*lime, **te raim** (*Citrus aurantifolia*)
*mango, **damanko** (*Mangifera indica*)
*native fig, **debero** (*Ficus tinctoria*)
*papaya, pawpaw, **dababaia** (*Carica papaya*)
pandanus, **epo, epuh!** (*Pandanus tectorius*)
*Polynesian vi-apple, **dagimadere, "Eigigu's tree"** (*Spondias dulcis*)
*Rangpur lime (*Citrus* x *limonia*)
*sapodilla (*Manilkara achras*)
*spinach tree, chaya (*Cnidoscolus chayamansa*)
*sugarcane **tugage** (*Saccharum officinarum*)
*tropical almond, **etetah** (*Terminalia catappa*)
*Volkameriana lime (*Citrus volkameriana*)

GENERAL PURPOSE/USEFUL TREES/ORNAMENTALS

ekaura, idibin kaura (*Sida fallax*)(I)
ekaura, inen kaura (*Abutilon asiaticum*)
*bamboo, **ebarabartu** (*Bambusa vulgaris*)
*casuarina, **Christmas tree, tanenbaum** (*Casuarina equisetifolia*)
*common hibiscus, **darot** (*Hibiscus rosa-sinensis*)
*cycad (*Cycas circinalis*)
*frangipani, **demeria** (*Plumeria obtusa*)
*frangipani, **demeria, arabaneit** (*Plumeria rubra*)
*ixora, **te katuru**, **te kaitiru** (K) (*Ixora casei*)

*jasmine, **rimone** (*Jasminum sambac*)
*kapok, **duwoduwo** (*Ceiba pentandra*)
*mother-of-cocoa (*Gliricidia sepium*)
*Pacific fan palm (*Pritchardia pacifica*)
*poinciana, **bin, "red tree"** (*Delonix regia*)
*sea island cotton, **duwoduwo** (*Gossypium barbadense*)
*Tahitian gardenia, **te tiare (K)** (*Gardenia taitensis*)
*yellow bells (*Tecoma stans*)
