COMBATTING LAND DEGRADATION

Niue

Niue's National Report on the Implementation of the United Nations Convention to Combat Desertification

Niue's National Report on the Implementation of the United Convention to Combat Desertification. Produced with financial assistance from the UNCCD Secretariat and the Government of Niue.

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CCD

UNITED NATIONS

E x e c u t i v e S u m m a r y

Niue is the worlds largest and highest single coral atoll, yet in contrast is the smallest self-governing nation. It is an unique island with an elevated rugged coastline and extensive forest cover, which comprises 65% to 70% of the land area. Niue is primarily an agricultural-based economy. Land degradation as a result of deforestation in Niue potentially places threats on soil fertility, structure and bio-diversity.

The expansion of agriculture is one of the major causes of land degradation, which is prevalent in Niue. The key agricultural activity in Niue is the growing of taro for export, resulting in large areas of land being cleared. Improved technologies for land clearing, such as the use of bulldozers, intensive agricultural practices and the increased use of agricultural chemicals have contributed to deforestation. Niue recently developed a forest policy which provides some guidelines for the conservation and sustainable development of the forest on the island.

The fertility of Niue soils is limited. Limestone outcropping occurs over approximately 50% of the island and many soils are deficient in organic matter, potassium and zinc. Traditional burning techniques was a concern as it reduced vegetation litter and exacerbating potassium reserve depletion. The use of bulldozers, however, maintains a litter herb ground cover to assist potassium cycling.

The discing program in the 1960's produced large areas where soils were severely depleted through being mixed in with churned up makatea to the point where only stunted growth of low ferns occurred.

Although land degradation in Niue has been recognized and well documented, no activity could be identified that addresses this issue specifically. However, developmental initiatives are generally accepted if sustainability is considered particularly where the environment is concerned, this is exemplified by the adoption of the National Forestry Policy, which serves as a guidance for sustainable development of Niue's forest.

Research programs that indirectly address soil degradation have been limited to small-scale extension projects. One such example, includes the 1992 Forestry Plantation project which was initiated partly in an attempt to replenish depleted soil areas through agro-forestry development and also to utilise and re-vegetate desert areas. The project however, was not a total success and was reviewed in 1997. The outcomes of the review recommended the implementation of agro-forestry demonstration set-up with the aim of promoting soil rejuvenation through activities such as introduction of legumes in areas after taro crops were harvested.

Also, under the auspices of the AUSAID funded Land Marine Resource Unit Plan, GIS soil and land cover maps for Niue were produced and further collated into a basic land capability model. This will allow procedures to be put in place to ensure that the clearing of regenerating and primary forest is discouraged.

The most recent updated report on the status of Niue's environment, The Niue Biodiversity Strategy and Action Plan (NBSAP 2001) further recommended a number of activities targeting sustainable management of cleared lands for agriculture.

In addition, the recent attempt by Niue to adopt organic farming will introduce a number of practices that will further address issues of land degradation, such as improved organic content in soils and sustainable agricultural practices.

However there are pertinent policy and physical land practice changes needed to ensure the future sustainable use of Niue's soil and forest resources. Land tenure within Niue is interlinked with socio-cultural, socio-economic and physical practice factors. Given that land tenure is so inextricably linked to natural resource management in Niue, that to suggest changes to physical land practices only, as a means for sustainable use, would be wrong.

It is anticipated that proposed legislation currently in draft form such as The Environment Bill and the Integrated Environmental Planning and Management Bill 2000 will provide some control over management of all natural resources.

In summary, there are physical land management practice choices available that could ensure the future sustainable use of Niue's soil resources. The alternatives will need careful consideration and many may require scientific and economic feasibility studies.

C o n t e n t s P a g e

Acronyms

AusAid	Australian Aid
CBD	Convention on Biological Diversity
CST	Committee on Science and Technology
DAFF	Department of Agriculture, Forestry and Fisheries
DJLS	Department of Justice, Lands and Survey
DSIR	Division of Scientific and Industrial Research
EEZ	Exclusive Economic Zone
EIA	Environment Impact Assessment
EIS	Environment Information System
ESCAP	Economic and Social Commission for the Asia and Pacific
GIS	Geographical Information Systems
IUCN	International Union on Conservation and Nature
LMRUP	Land and Marine Resource Use Planning
LMRUPP	Land and Marine Resource Use Planning Project
NEMS	National Environmental Management Strategy
NBSAP	National Biological Strategic Action Plan
NZ	New Zealand
NZODA	New Zealand Overseas Development Assistance
PWD	Public Works Department
SOE	State of the Environment Report
TPN	Thematic Programme Networks
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations Framework Convention on Climate Change
USP	University of the South Pacific

NPK	Nitrogen Phosphorous Potassium
Fe	Iron
$CaCO_3$	Calcium Carbonate
P	Phosphorous
Ca	Calcium
C	Carbon
N	Nitrogen
ha	hectare
m	metres
km^2	square kilometres
km	kilometres

G l o s s a r y

Niuean words

Makatea	-	Fine granulated rocks derived from Calcium Carbonate parent material
Tapu	-	Forbidden, protected, placed under taboo
Fono	-	Prohibition placed on an area (land or sea) to protect it and its crops or resources (eg. Coconut leaves tied around fruit trees indicate both trespass and the taking of crops are forbidden)
Magafaoa	-	Extended families
Uga	-	Coconut Crab (*birgus latro*)
Lupe	-	Pacific Pigeon

A c k n o w l e d g e m e n t s

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CHAPTER 1

1.0 Introduction

Increasing attention has been given to a need to address issues related to protect global environment and promote sustainable development in a comprehensive manner. Island countries in the South Pacific have been vigorously promoting the implementation of the UN Framework Convention on Climate Change (UNFCCC), the Convention on Biological Diversity (CBD) and other international and regional agreements and programmes for protecting marine environment.

As one of the international conventions emanating from the 1992 UN Conference on Environment and Development (Rio Earth Summit), the Convention to Combat Desertification (CCD) was adopted in June, 1994 and came into force in December 1996. One hundred and sixty-two countries have already ratified and acceded to the CCD. It addresses issues related to combatting desertification and mitigating the effects of drought and promotes regional collaboration in an order to achieve common objectives. Land management policies are also regarded as important in mitigating climate change, preserving biological diversity and protecting marine environment. In recognition of the magnitude of environmental and socio-economic impacts of desertification, land degradation and drought, as well as being of great relevance to their national policies on environment protection and sustainable development, 13 island countries in the South Pacific ratified to the United Nations Convention to Combat Desertification (CCD).

The CCD advocates the enhanced concerted endeavours to combat desertification and mitigate the effects of drought. The Committee on Science and Technology (CST) under the auspices of the Conference of the Parties to the CCD, has been carrying out the work on benchmarks and indicators and early warning systems. These are issues that are of significant relevance to enhance land based-resource management and to promote measures to prepare for drought and mitigate its effects as the South Pacific islands have experienced serious droughts, due to El Niño and La Niña phenomena.

The CCD promotes regional cooperation to combat desertification and to mitigate the effects of drought. The CCD Regional Action Programme for Asia has been developed, which is composed of 6 thematic programme networks (TPNs) to address:

i) desertification monitoring and assessment
ii) agro-forestry and soil and biological diversity conservation

iii) range-land management and sand dune fixation
iv) water management in dry lands
v) capacity building for drought mitigation
vi) local development initiatives.

Some of these, particularly TPNs 1 (network on desertification monitoring and assessment) and 5 (network on capacity building for drought mitigation) are deemed of particular relevance to South Pacific island countries in enhancing activities to observe land use changes and climatic variations, and strengthen measures to prepare for drought and mitigate its effects. TPN2 (network on agroforestry and soil conservation) can also offer island countries an opportunity to pursue effective agro-forestry and soil conservation techniques and practices.

CHAPTER 2

2.0 National Circumstances

2.0.1 Background

Niue is the worlds largest raised single coral atoll situated in the Southwest Pacific Ocean at latitude 19º south and 169º west. The land area is comprised of 259 km^2.

The Exclusive Economic Zone (EEZ) of Niue is 39,000km^2 of the South Pacific Ocean. Within its EEZ Niue has two atoll reefs, Antiope and Beveridge, visible only at low tide, from which commercial fishing is banned on these reefs.

2.0.2 Geography

Niue lies approximately 480 km east of Tonga, 930 km west of Rarotonga in the Cook Islands and 660 km south east of Western Samoa.

Niue atoll is comprised of three terraces, the rim of the lower terrace averages 28 m above sea level, with the upper rim averaging 69 m above sea level. The majority of the slopes of the terraces are rough, with jagged coral rocks, boulders, and many crevices and holes. The island has a rugged rocky coastline, featuring steep cliffs, caves, deep chasms and blowholes. The reef is continuous, and is breached at one small area opposite the Alofi wharf (NEMS 1994).

There is no surface water on Niue, but artesian bores enable a subterranean reservoir of fresh water to be tapped for domestic and agricultural purposes.

2.0.3 Climate

Niue lies on the edge of the southern tropical cyclone belt and in the zone of the southeast trade winds, and hence is subject to strong gale force winds. There are two distinct seasons in Niue, the hot wet season from November to March, characterized by high temperatures and humidity, and the cool dry season from April to November, characterized by warm sunny days and cool nights. The hot wet season also coincides with the tropical cyclone season.

2.0.4 Rainfall

The average rainfall is approximately 2,180mm but can vary from 810 to 3,300mm per annum. The bulk of rainfall is concentrated in the wet season often in torrential downpours (accounting for 68% of the total annual rainfall). However the annual rainfall pattern is erratic, and very dry or very wet months can possibly occur at any time of the year.

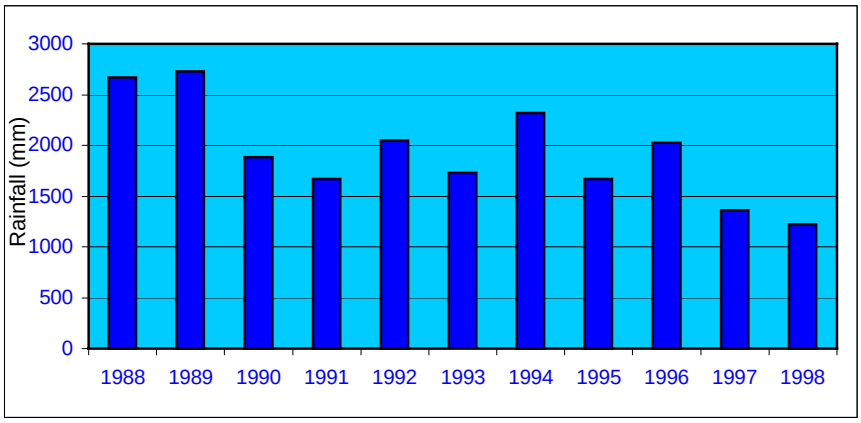

Fig 2.2 Annual Rainfall for Niue

2.0.5 Temperature

Annual average temperature does not vary greatly throughout the year due to the influence of the sea on the small low-lying island.

At the height of the wet season mean daily maximum temperature is 30ºC (January/February) with a mean daily minimum of 23ºC.In the dry season the lowest mean daily maximum is 26ºC and a mean daily minimum of 19ºC.

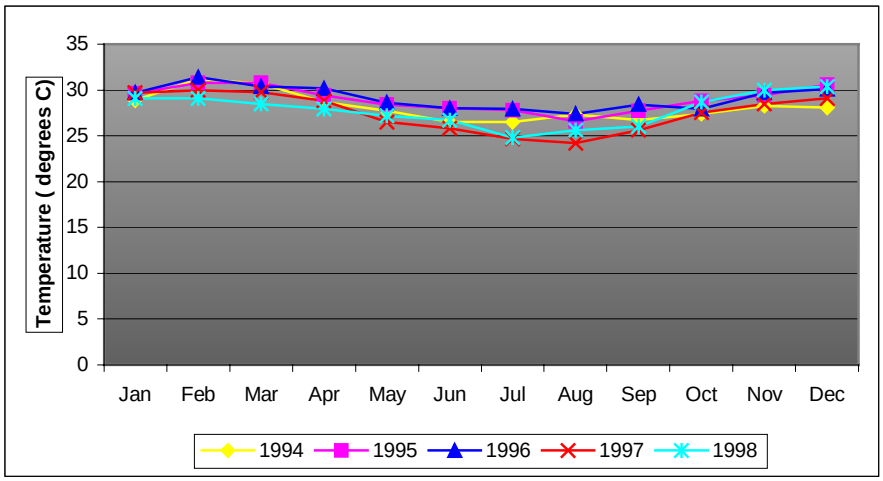

Fig 2.3 Mean Monthly Temperature

2.0.6 Education and Training

The education system is based on the New Zealand model, and hence seeks similar achievement objectives.

Education is compulsory between the ages of 5 to 16 years. Educational development is a high priority for the Government of Niue, with a 99% literacy

rate. Since 1989, primary schools have been centralized in Alofi, due to the declining number of pupils in the outer villages. There is only one secondary school also situated on the outskirts of Alofi. The government wishes to introduce compulsory, free education, while incorporating Niue's traditional arts and crafts and promoting bi-lingualism.

The University of the South Pacific (USP) extension centre is located next to the Niue High School, and is the only post secondary education facility on the island. The USP offers extension courses at the diploma and degree level, in addition to vocational and community education programs.

Other students pursuing tertiary qualifications travel abroad, often on scholarships (through bilateral aid programmes from New Zealand, Australia and World Health Organization) which allows study at institutions in Fiji, New Zealand, Samoa, Vanuatu and Australia.

The Government of Niue accepts that there is minimal realistic prospect of economic self-sufficiency however current development policy focuses on tourism and private sector development through increased employment opportunities and agriculture production as mechanisms to reduce aid dependency.

2.0.7 Agricultural Sector

The coral atoll origins of Niue have left it with scenic coastal areas but with limited soil depth and fertility. Throughout the island, the soils are of marginal fertility for intensive agriculture and long-term monoculture. Much of the land is covered with fern growth, which again indicates the poor structure and nutrient content of the soils (NEMS 1994).

Thirty to forty percent of Niue's land is unsuitable for agriculture while those under cultivation are only at the subsistence level. Farming is centred on bush gardens, which are cleared by bulldozers, with taro as the predominant crop. An increase in taro production evolved as a modest export product to New Zealand. Other crops include: cassava, sweet potatoes and yam. Small quantities of coconut, lime, banana, fruit and vegetables are also cultivated mainly for domestic use. Ongoing research is currently being undertaken to develop other cash crops such as vanilla for export or for processing. Livestock includes: chickens, pigs, and a small number of cattle.

2.0.8 External Trade

Niue is dependent on imports for all consumer and capital goods apart from food staples and basic construction materials. New Zealand is by far Niue's largest trading partner, though Australia and neighbouring Pacific Islands also provide a source of imports and export destinations to a small degree. Of these, Fiji is the largest, being the only source of bulk petroleum fuels.

Exports are largely comprised of taros sold in New Zealand, and previously to American Samoa. Small quantities of honey, dry coconuts, bananas, yams, vanilla and handicrafts are also exported to New Zealand. Passengers also carry significant volumes of taro, green coconut and coconut crabs (an estimated two tons/year) to New Zealand, as gifts for relatives or informal resale. A major component of "consumer goods" production are handicrafts which are exported on a small scale to galleries in New Zealand, Australia and Hawaii.

2.0.9 Water

There is no surface water in Niue. Rainwater seeps down to an underground lens. Water is then pumped from fifteen bores into header tanks or reservoirs and then reticulated untreated to houses in each village.

Water quality sampling indicates that there has been little change over time in terms of pH, temperature, sulphate, iron, chloride and nitrate content. The water is generally of good drinking quality but has high levels of iron present.

However, a number of agricultural practices, in particular the use of chemicals (biocides and fertilizers) and the keeping of livestock pen close to where water is extracted, were a threat to quality. This problem has since been addressed. (NEMS 1994, SOE 1994).

Land Use Change and Forestry

Evidence suggests that Niue was well forested until very recently. It is thought that up to 90% of the island was covered in forest until the 1950s. However, since then, deforestation has been severe. Extensive areas of fern dominated shrub land and regenerating forest have now replaced much of this original forest.

However, Niue is still largely covered by tropical forests, 18,200 ha or 64% of the island (this includes both primary and secondary re-growth). Thus at 8.7 ha of forest per capita, Niue has one of the highest forest areas per inhabitant amongst island countries of the Pacific Region.

The expansion of agriculture is generally one of the chief causes of deforestation, and this is prevalent in Niue. The key agricultural activity in Niue is the growing of taro for export, resulting in large areas being cleared.

There is growing concern at the progressive decrease of indigenous forest areas. Over the last 30 years, the people of Niue have cleared an additional 22% of the indigenous forests, a reduction in the overall forest cover on the island from 86% to 64%. This is equivalent to a rate of deforestation of 0.9% per annum of the original 1966 forest cover. This deforestation occurred at the time Niue was undergoing its most rapid depopulation and coincided with a need to increase cash income. Improved technologies for land clearing, such as the use of bulldozers, and intensive agricultural practices, such as mono cropping of taro for export and increased use of agricultural chemicals were contributing factors for larger land areas being cleared at a time.

More recently the reduction in fallow period in some areas further exacerbates reduced soil fertility.

Vegetation Type	**Estimated Area 1966[1] (ha)**	**Estimated Area 1981[2] (ha)**	**Estimated Area 1994[3] (ha)**
Coral reef littoral scub			1,335
Littoral/Coastal Forest	2,441	2,276	1,441
Light & regenerating forest	14,358	12,735	11,434
High canopy forest	5,775	3,288	5,583
(Merchantable)	3,619	7,874	6,080
Open areas			
Total area Niue	26,173	26,173	27,867[4]

Table : Niue Vegetation Types and areas

[1] Frost and Berryman (1966), adjusted by GIS, F. Martel & Associates (1997)

[2] Forestry Division (1990), adjusted by GIS, F. Martel & Associates (1997)

[3] Department of Justice, Lands and Surveys (1997) from Forestry Division mapping.

[4] Possibly due to errors in adding polygons – 1994 figures cannot be compared with previous survey areas.

Overall, logging of the high rainforest for timber played only a small role in the forest loss between 1966 and 1994 while most deforestation was attributable to clearing for agriculture and, in some cases, accidental burning.

There is a local timber industry that has an annual harvest of 230m^3, which is well within the sustainable level of the indigenous forest of Niue. The local timber industry is small in nature but is supportive of the sustainable concepts and methods of harvesting.

The Niue Government is supportive of the National Forest Policy currently being implemented for Niue whereby the guideline promotes conservation and sustainable development of the forest on the island.

2.0.10 Bio-diversity

Due to its isolation and distance from the other islands in the Pacific, Niue has limited naturally occurring fauna and flora. This isolation also contributed to the relatively small number of introduced species present in Niue.

a. Flora

Niuean plant species have been researched and documented. However there has been no recent work done on the relative abundance and distribution of species.

In the 1943 Survey of Plants, T.G.Yunker identified 456 species of vascular plants excluding cultivators in the flora of Niue Island publication. It was assumed by later studies in 1965 by W. R. Sykes that the records were fraught with errors of identification. An updated account lists 629 taxa of a variety of vascular species, which consists of an estimated 175 indigenous species and a few cultivars.

b. Forests

i. Inland Rainforest

This forest is composed of both original primary forest and modified mature growth. Closed canopy high stature forest is found throughout and is largely dominated by two tree species, *Syzgium inophylloides* (kafika) and *Syzgium richii* (kolivao). Other common species include: *Dysozylum forsteri* (moota), *Planchonella torricellensis* (kanumea), *Pomentia pinnata* (tava), *Macaranga seemanii* (le) and *Fiscus prolixa* (ovava). Major understorey trees include *Polyscias multijuga* (tanetane vao), *Streblus anthropophagourm* (atatu), *Merremia peltate* (fue vao) and epiphytic and ground ferns (kapihi, luku and mohuku tane).

ii. Coastal Forest

The coastal forest is dominated by species similar to those found in the inland forest. However the coastal species tend to be stunted as are exposed to salty winds. Seawards there is more open scrub and include the species *Barringtonia asiatica* (futu), *Capparis cordifolia* (pamoko), *Timonius polygamu* (kavetutu), *Ochrosia oppositifolia* (pao), *Pandanus tectorus* (fa fi), *Scaveola taccada* (pao) and *Messerchmidia argentea* (taihune). Within 50 metres of the coast there is only *Pemphis acidula* (gigie).

Scattered areas and agricultural clearings are dominated by pioneering species such as *Hibiscus tiliaceous* (fou), *Morinda citriflora* (nonu) and *Macaranga harveyana* (le hau). Ferns are also present, the dominant species being *Nephrolepis hirsutala* (mohuku).

CHAPTER 3

3.0 National Plans and Strategies

3.0.1 National plans and strategies available in the field of combating desertification developed prior to the UNCCD.

The Land and Marine Resource Use Planning Project (LMRUP) was an AusAID project set up at the request of the Government of Niue based on several national reports such as the NEMS (National Environmental Management Strategy 1994) which identified gaps in the environmental information and decision making platforms available in the country.

The aim of this project was to establish a resource use planning system that enabled the collection and storage of sound data in order to make informed decisions in the sustainable use and protection of our natural resources.

The main outputs of the project where as follows:

3.0.2 National Environmental Planning Strategy

This strategy was set up into 5 parts.

Part 1. A General Background
A general background to the LMRUP including aims, projected outputs, general process and project components (Resource inventory and audits). The set up of a Geographical Information System (GIS), local area plans, institutional strengthening and capacity building.

Part 2. Principles and Approaches to Environmental and Resource Use Planning
Why plan?: IUCN Conference, International Environmental Obligations, planning approaches, current issues and problems, frameworks for implementing planning (Environmental Planning and Management Law), Strategic Plan Generation, Sustainable Development Guidelines, Planning or Environmental Information Guides.

Part 3. Status of Planning for Sustainable Development
This part centers on the primary issues or threats to achieving sustainable development. It also reviews the status of separate environment sectors of relevance to institutionalizing environmental planning here in Niue. This part covers land tenure, land, resources and sustainable development. An overview of Land Resources covers such topics as soils in general, nature of agricultural use, land degradation issues, and Niue's response to these issues and the effectiveness of the response.

Part 4. Environmental Planning Policy
This part outlines the aims, objectives and opportunities for land and resource use planning and sustainable development. Whereas Part 3 identifies issues, needs and objectives in decision making, this Part provides the planning response to that Status reporting. Opportunity-based mapping is a component of this part and covers various themes such as; Tourism, Conservation, Waste Management, Major Land Use, Agriculture, Soils.

Part 5. Capacity Building for Environmental Planning and Management
This Part canvasses actions to increase capacity building in the areas of data collection, analysis to support ongoing environmental and resource use planning and the management of resources.

3.0.3 Niue National Environmental Plan

Also a product of the LMRUP. This Plan is an Environmental Instrument under the DRAFT Integrated Environmental Planning and Management Bill, 2000.

3.0.4 Sustainable Development Guidelines

A product of the LMRUP, these guidelines outline procedures for the sustainable development of different resources with regards to certain main development areas.

At this stage they cover: Land Development (Design and Siting), Guidelines on the Content and Processing of Environmental Impact Assessments, Village Planning (Local Area Plans), Flora, Fauna and Biodiversity Studies, Landscape Assessment, Tourism Development, Commercial and Industrial Development, Multi-Unit Dual Occupancy Residential Development, Solid Waste Management.

Government has the option to nominate other resource use policies as "Sustainable Development Guidelines", as in the Forest Policy in order to gain stature under the Draft Integrated Environmental Planning and Management Bill 2000.

3.0.5 Status of Plans and Strategies Relevant to Combat Desertification

3.0.5.1 What is their status? Are they formulated? Are they being implemented? Since when have they been operational?

Tools under the Resource Use Plan are being implemented as of this year (2000). Their full implementation depends largely on the government's stance, whether to pass the bill or combine it with another Environment Bill. Until legislation is passed, these documents take an advocacy role in the decision-making system of development.

3.0.5.2 Do these plans and strategies have any reference to the combat of desertification or connection to the CCD/NAP?

Yes.

(a) Land, Resources and Sustainable Development

Land degradation from unsustainable rural land use in Niue potentially place threats on soil fertility, soil structure and stresses on bio-diversity through loss of native forests. This section defines the nature of the shifting agricultural land use in Niue, the land degradation issues, and their status and possible long-term implications. In addition it discusses the attitudes behind previous initiatives for sustainable land use and conservation, highlighting the cultural importance of land to the community and the inter-linkages of past failures to problems with land tenure. Alternative approaches, policy change and new physical land use practices are canvassed with the advocacy of increased recognition and respect of traditional knowledge and practice, in tandem with western scientific endeavors.

Soil and bio-diversity degradation in Niue are symptoms of more dynamic and complex problems facing the community. This section explores the cultural and socio-economic factors contributing to current rural land use practices. Possible alternative approaches to land use and management is canvassed as a means to ensure sustainable use of Niue's limited land resources.

(i) Overview of Land Resources

Niue is unique in terms of its physical, cultural and socio-economic characteristics. It is a raised coral atoll, with dramatic limestone cliffs rising 20-30m above the sea. It is 260 km^2 in area, supporting a population of about 1700. Much of the rural land is inaccessible for large area subsistence commercial agriculture, and in many areas is not accessible by foot. In some areas the extent of coral outcropping (makatea) can be as much as 90%. A traditional system of 'tapu' and 'fono' protection areas, placed on land (and marine) areas by the family group (magafaoa) or local Village Councils, has helped in the retention of 65% of the country's 'primary forest'. A further 10-15 % may be healthy regenerating bush or long-term fallow areas (i.e. >20 years). The remaining 'open areas' are a mix of bush gardens (subsistence patches), fallow areas (ranging from 5-

20 years), and degraded soil areas (locally referred to as 'desert' or 'fern-lands').

(ii) Soils in General

The fertility of Niue's soils is limited due minimal depth to base-rock, makatea outcropping and surface boulders (Wright and Westerndorp, 1965; Widdowson 1965). Makatea (limestone) outcropping occurs over approximately 50% of the island. Many soils are deficient in organic matter, potassium and zinc (Blakemore et al 1979). Disc clearing of rock outcrops in the 1960s degraded much of the more productive and flatter areas of the island. It brought calcium into the top-soils, which created K, Mg and Ca imbalances and restricted the uptake of essential nutrients by plants (Wright and van Westerndorp, 1965). These areas have become overgrown with ferns or remain as bare earth areas.

(iii) Nature of Agricultural Use

Rotational or shifting agriculture is practiced on Niue with the growing of taros (*Colocasia esculenta*) as the primary crop. Farming on the steep and rocky coastal areas is undertaken mainly by slash and burn techniques, or slash and mulching due to the inability to use mechanized forms of agriculture. Further inland, beyond the coastal ridge within the areas of flatter country each family have their communal or individual plots where larger areas are used for taro, other root vegetables, fruit trees and traditional herb plants. The inland plantation plots range in size from 0.5ha to 2ha, with the average size being about 1ha. Plantations cleared some 20 years ago were planted with taro once, with the family groups moving onto a nearby patch in the following year. Overuse of burning techniques was a concern in these times as it drastically reduced the amount of vegetation litter, exacerbating potassium reserve depletion (Wright and Westerndorp, 1965). Fallow periods of over 12 years were needed for soil replenishment. In the 1960s when bulldozers were first used, they were seen as a mechanism to clear land sensibly by knocking over re-growth, trees and shrubs but maintaining a litter and herb groundcover to assist potassium cycling. Fallow periods were reduced to about 5-8 years and recently further reduced to 3-5 years.

(iv) Land Degradation Issues

Soil Fertility and Structure Decline

The primary soil related problem is soil fertility and structure decline. Physical changes to land use practice have seen the reduction in the fallow period. Clearance and use of primary forest and less fertile areas of the island; reliance on fertilizer to improve crop production; increased use of trash burning; and use of weedicide in lieu of manual clearing and mulching techniques have all exacerbated these problems.

The fertility of Niue's soils is limited due to minimal depth in the base-rock, makatea outcropping and surface boulders (Wright and Westerndorp, 1965; Widdowson 1965). Many soils are deficient in organic matter, potassium and zinc (Blakemore et al 1979). Maintenance of ground litter, mulching practices and canopy cover can assist these shortfalls.

Wright and van Westerndorp (1965) indicated that soil structure decline was approaching a critical condition. They reported large areas where soils were depleted and increasing areas where soils were 'severely depleted' to the point where only stunted growth of low fern occurred. The biggest single contributor to soil structure and fertility decline was the disc-ploughing program in the early 1950's and 1960s. This was a donor agency funded program, which aimed to open up larger areas to extensive agriculture, through removal of rock outcrops and deep ripping of the soils.

In their investigation, Widowson and Leslie (1965) reported that the discing program did increase the area of crops cultivated and made the land easier to plant. This outcome, however, placed further pressures on the soils. Repeated discing resulted in poor crop yields despite the use of N.P.K fertilizes which simply enriched the topsoil with makatea (lime). An over supply of calcium in the topsoil is harmful to crop growth for a number of reasons. Repeated cultivation decreases organic matter in the soil and this in turn will reduce the water holding capacity and nutrient supply, and breaks down the structure of the. The makatea (limestone) is low in plant nutrients (apart from calcium and magnesium), and 'dilutes' the nutrient content of the topsoil. Increased calcium content reduces plant uptake of potassium and

magnesium. An increase in the topsoil pH decreases the availability of minor nutrients especially zinc, iron and manganese.

Clearance in Agricultural Production Areas

Traditional slash and burn, and mulching techniques were used interactively in agricultural production areas prior to the arrival of bulldozers on the island in the 1960s (Blakemore et al, 1979). Care in the timing of respective techniques meant that there was a balance between the volume of produce removed from the land and what was left as vegetative trash to replenish essential elements and micronutrients. Over the last 30 years there has been a gradual reduction in their use to the point where 80% of all agricultural households now use a bulldozer to clear land (Statistics Unit, 1989). Bulldozers create havoc in terms of extensive and quick clearance of trees and shrubs and have also been known to inadvertently destroy heritage sites.

The previous practice of a 7-12 year fallow period, which allowed limited soil replenishment, is now threatened by the ability to cheaply clear larger areas of bush by bulldozers. Mulching has been replaced with greater reliance on costly synthetic fertilizers. A reduction in real incomes over recent times due to government downsizing, and the desire to increase taro production has resulted in pressures to expand production areas. Fallow periods have generally been reduced to about 5 years in some areas, 3 years in others, and for some areas there is continued cropping (Forestry Section, 1998).

Clearing of Forests for Agricultural Use

The extension of agricultural sites now involves a greater level of indigenous forest clearing through a combination of bulldozing, trash burning and the planting of taro (SPREP, 1997). Taro will grow well on the soils of the primary and regenerating forest areas. This is not so much due to their long-term sustainable fertility and physical capacities - but due to the fact that they have had a long-term nutrient build up from canopy cover and vegetative.

Mapping for the Forest Policy completed in 1997 (Forestry, 1998) using mapping of 1990 (Forestry Section, 1990) revealed that the primary and regenerating forests had been reduced by 30 percent in the period from 1966 to 1994, with

the higher percentage of clearance in the period from 1981 till 1994. From this period the population of Niue had dropped from 5000 to 2750 (Statistics Unit, 1995). This indicates that in addition to physical land practices, there were additional socio-economic factors placing pressures forest on resources. On the physical side, the use of bulldozers in lieu of slash and burn techniques has meant that areas previously constrained can be worked.

(v) Status of the Land Degradation Issues

Status of Soil Fertility

Previous soil surveys and sampling (Widdowson 1965, unpublished; Wright and Westerndorp, 1965; Blakemore et al, 1965;) provide the following generalizations about the status of Niue's soil fertility:

Nitrogen is low in all soils and is rapidly depleted. Calcium and magnesium are abundant in all soils, pH was high in all soils. Phosphorus is high in all soils tested and is adequate for crop growth. Potassium is low in most soils and is likely to limit crop growth where removal in produce has depleted soil levels. Sulphur is also low in all soils and like potassium, may also limit crop growth; sodium is adequate for crop growth in all soils. Of the trace elements, zinc is consistently in short supply.

The outputs of studies in the 1960s, 70's and early 80's and subsequent fertilizer experiments recommended that a fertilizer mixture of N.P.K (11:2:15) be used for optimum taro crop yields. Blakemore et al (1979) indicated that addition of zinc sulphate would correct the zinc deficiency.

Recently, questions based on work undertaken by DAFF, have been raised about the suitability of the previous fertilizer mix. The inclusion of phosphorous has been questioned and the amount of potassium may not be sufficient. Therefore, there is a need to investigate possible fertilizer mix variations involving nitrogen, potassium, sulphur and zinc and to work out the rates that would be suitable for the different soils of Niue for particular crops.

Soil Structure

Due to increased land tenure conflict, fragmentation and sterilization of land, limited suitable agricultural land and

other socio-economic factors, fallow periods have been reduced drastically. The result is that production areas are not left long enough for the soil to recover and with continued cropping, use of bulldozers and reliance on synthetic fertilizer, over time, soil structure decline will become more prevalent.

Threats to Bio-diversity

Species diversity in Niue in terms of numbers, richness and variety is considered limited due to its size and isolation (SPREP and Environment Unit, 1999). The island has a very small biomass and the population density of the most common wildlife has a segregated distribution that is prone to cyclone and other natural or human induced hazards and also to the hunting pressure on some species. Areas occupied by certain species, uga (coconut crab), for instance has decrease to some extent. Conservation of endemic flora and fauna and sustainable use of all land resources is therefore critical. Studies as part of the bio-diversity project suggest that the fruit bat (*Pteropus tongianus*), coconut crab (*birgus latro*) and pacific pigeon (*Ducula pacifica*) are "threatened" or "highly vulnerable" and are nearing the "endangered" status (SPREP and Environment Unit, 1999).

The relative abundance and distribution of many species is unknown. In many parts of the island the primary and regenerating forests have now been replaced by fern dominated shrub-land signifying low soil fertility and structure decline.

The major threats to the island bio-diversity is a combination of the continued clearance of the forests, hunting pressures on the coconut crab, fruit bat and pacific pigeon (access is increased as land is cleared).

(vi) Longer Term Consequences

Continued clearance of regenerating secondary and primary forest will lead to pressures on the island's bio-diversity. Forests will eventually reach a point where its natural buffers to threats will be destroyed. The resilience of the forests to replenish themselves after major natural hazards (e.g. cyclones, bush-fires) or man's harmful effects (e.g. pollution) will be reduced. Habitats of the limited faunal species will be threatened. Regenerating secondary forests contain endemic and introduced fruit species, which are the

diet of two vulnerable species - the fruit bat (peka) and the pacific pigeon (lupe) (SPREP, 1995). Clearing of agricultural areas without the retention of ground-litter and selected 'traditional' medicine and food trees could see the diminishing of seed stock and eventual threat on the survival of species. Absolute clearance without fallow periods could also result in loss of genetic diversity of plants and microorganisms.

Continued use of synthetic fertilizer, combined with continued bulldozer clearance with minimal vegetation litter and limited fallow will result in soil fertility depletion and over time may exacerbate soil structure decline.

(vii) Responses and Their Effectiveness

There have been a number of development assistance agencies and Government of Niue initiatives to assist with better use of rural areas. In the 1960s there was the disc-ploughing program reported on earlier and the establishment of a honey industry, which was successful until the premature death of the NZ owner. In the 1970s passionfruit, coconut by-product and lime industries were initiated. A cattle farm was also initiated on Crown lands but suffered from an inability to grow enough stock-feed for the breed chosen. Each of these failed mostly due to economies of scale (after early heavy subsidisation by overseas donors), in addition to poor growing results and eventual cyclone devastation.

In the 1992 the Forestry Plantation project commenced and aimed to replenish (financially and physically) depleted soil areas through agro-forestry development. Poor inception, poor growth of exotic species chosen, monopoly leases and land tenure conflict saw this initiative scaled back to an advisory program in 1998 (Forestry Section, 1998). A recent review has shown that the initial program economics were faulty and through most of the life of the project there was

again heavy reliance on overseas subsidisation. The program was never well accepted by the community which was said to be due to a lack of understanding and awareness, but more likely due to poor consultation and participation in the design, scope and inception of the program.

Soil programs have been limited to small-scale extension projects, fertilizer and fodder experiments. A Land Titling program commenced in 1991 and while successful in providing a means for survey and registration of land, it did not tackle one of its intended objectives - the improvement in land tenure determination. The program was tied to the Forestry Plantation project in 1995 in a bid to increase the success of that program. The opposite occurred and any misgivings felt previously by the community were confirmed. Both these programs were funded by NZODA.

The Bio-diversity program (SPREP, 1995) itself a capacity building exercise aimed to offer conservation of forest resources involving income generating options, has met with recent criticisms. A recent output recommended formal reserves over core areas of the forest and was received as an absolute travesty of village, family, traditional and individual rights. Not only does the Bio-diversity Convention recognize alternative protection mechanisms it advocates use of these where successful. The areas of the Huvalu forest nominated are covered by "tapu" which have deterred entry by humans for many years.

(viii) Influences of Land Tenure and Socio-Economic Factors

It is acknowledged that environmental damage or degradation is exacerbated by or is a result of underlying socio-economic and political "realities". Land tenure conflict, downsizing of the government employment sector, increased immigration, improved quality of life, increased cost of production, availability of modern machinery, donor agency subsidisation, and communal societal ties with land have all in various ways resulted in increased pressures on land and soil resources.

Until the late 1970s, the communal sharing ethos of the Niuean community prevailed and provided a means for inequities in tenure, production, sustenance and quality of life, to be mitigated. Globalisation factors saw a shift from communal sharing to pushes for 'individualism'. These have mainly come from 'western' influences in cash and market

economy development. Banking, insurance, business and development assistance emphasizes individual security and compensation for use, development or production. There has also been a drop in government employment, which has lowered the disposable cash reserves of families and individuals. Against this background in addition to the taro blight in Samoa, has resulted in an increased demand for Niuean taro in Samoa and in New Zealand.

The land laws inherited from New Zealand provide very flexible inheritance mechanisms without the corresponding re-distribution mechanisms (e.g. alienation, consolidation of parcels) of western tenure systems. Overall the response to these 'foreign' factors has been an increase in land disputes, firstly between families and now within. As land disputes rise there is greater fragmentation and economic sterilization of agricultural lands. New 'fresh' areas free from family or individual conflict are pursued (primary forest areas) or plantations are subject to reduced fallow periods with heavy reliance on costly synthetic fertilizer. Fallow periods have been reduced to about 3 years in most areas, while in others there is continued cropping (Forestry Section, 1998). Both scenarios combined with current land practices are threatening bio-diversity and the soil resources of Niue.

Many responses to date have failed due to a lack of appreciation and awareness of all local factors by overseas assistance personnel/players rather than a lack of effort on the part of the local people.

(ix) Improved Management Philosophy and Technological Alternatives

Possible Alternatives and Improved Implementation Mechanisms

Any alternatives put forward to deal with rural land use pressures and land degradation need to understand and respect the inter-linkages between land tenure, use of soil resources, bio-diversity conservation, constitutional and customary rights, socio-economic factors and cultural values in Niue. Many responses to date have failed, due to a lack of awareness and attitude problem with overseas assistance players, not that of the locals. There will be no simple solution to land use pressures, depletion of soil resources and clearance of forests in Niue. For instance due to socio-cultural values and rights, and prior interpretation of existing

laws, uncertainty over any sustainable economic or conservation initiative will prevail unless the land laws are changed. If new initiatives are generated with the early and responsive involvement of locals many endeavours could provide some benefit and would be accepted within the constraints of the current tenure system. Despite the land laws some on-the-ground administration and land practice changes could be varied to ensure there is less pressure on the islands land resources.

Attitudes Towards Land Tenure and Resource Management Initiatives

Land Tenure matters are the country's primary problem not only in terms of facilitating sustainable economic development, but also in terms of initiatives for bio-diversity, sustainable forest management and environmental planning. A key statement in the country's National Environmental Management Strategy (SPREP, 1994) was that "any environmental or sustainable economic initiatives should be considered and implemented within the context of the land tenure and management system of Niue".

Compulsory titling of land was seen as a means to reduce problems in the Land Titling Program commenced in 1991. However Niueans have absolute resource rights under their Constitution and the program had to shift to a voluntary process. Niueans are suspicious of the intentions of the land-titling program and so far, see it as only heightening conflict.

While it can be recognized that some changes may be necessary, modern land management and environmental initiatives need to respect the human and cultural rights of indigenous people, and indeed gain their respect, if conservation endeavours are going to succeed. This is a notion expounded by many environmental conventions and instruments from the 'Rio Declaration' in 1992 (Agenda 21, Biological Diversity, Climate Change and Forest Principles), the Barbados Declaration (1994) and the International Tropical Timber Agreement (1994). The benefits of indigenous or local peoples' involvement for 'good governance' of sustainable development and bio-diversity conservation initiatives (co-management) have been commonly expounded.

There is a need to show respect for sovereign rights, provide a climate to win over and use indigenous knowledge, and to aspire to co-management ethoses. The community needs to be involved at the outset of program design and implementation, to strive for a 'sense of ownership'. Participation rather than consultation should be the redeeming principle in ensuring the sense of ownership.

Land Evaluation and Appraisal

Despite numerous scientific studies of Niue's soils (Widdowson and Leslie, 1965; Wright and van Westerndorp, 1965; Blakemore et al., 1979, NZ D.S.I.R, 1985) before the LMRUP there was no attempt to evaluate the capabilities and suitability of Niue's soils. From the 1985 work (NZ D.S.I.R., 1985) a map of soil families existed in digital form. Data on physical and chemical properties, characteristics and description existed but was desegregated and there were many gaps. Data has now been linked to the soil map and used for strategic land evaluation incorporating land classification and land appraisal (capability and suitability analysis) rating system that respects Niue's unique soil and other environmental attributes. This would be a useful base for extension soil officers as well as subsistence and cash crop farmers.

Models of land evaluation, land capability classification and suitability assessments include that initially generated by the USDA (capability only), and many derivatives. Additionally there are many on-the-ground applications using an adaptation of the USDA method and incorporating 'suitability' criteria similar to that promoted by ESCAP, 1997. As an output for the LMRUP a very basic but useful suitability, rating system has been developed and soils data can be queried on the basis of 18 fields of data, such as depth, zinc deficiency, best crops etc.

Given the unique nature of Niue's landform, geomorphology and biophysical characteristics as well as a shifting agriculture history, standard capability and suitability classifications may not be suited. Useful examples of other methods for unique soils and landform include that reported on in ESCAP (1977).

Alternative Agricultural Practices

Reducing or stopping subsidisation of bulldozer use is an economic initiative that would change inappropriate physical land management practices. This action could be combined with a number of other administration and practice restrictions:

There now exists a means to determine the location of intended clearing through use of land-cover maps over cadastral bases. Procedures could be put in place to ensure that clearing of regenerating and primary forest is deterred, or at least the planned clearing be discussed with the landowner to advocate nearby alternative areas.

Providing incentives to use fallow areas or scrub through variations to charge out rates could control the intensity of clearing in sensitive forest areas. Full cost recovery rates could be applied to landowners who intend to clear regenerating or primary forest areas.

Practice notes and training could guide bulldozer drivers to ensure that reasonable levels of vegetation litter is left after clearance, and that the blades of the dozers do not disturb the soils.

The D8 bulldozer could be restricted to public infrastructure work, or land clearing in previous fallow areas. The D6 bulldozer is incapable of clearing large tree and bush-cover associated with healthy regenerating or primary forest.

(x) Synthetic Fertiliser Problems

Continued use of synthetic fertilizer, combined with continued bulldozer clearance with minimal vegetation litter and limited fallow periods will result in soil fertility depletion and over time may exacerbate soil structure decline. As previously mentioned in *Status of Soil Fertility* questions have been raised about the suitability of the previous recommended fertilizer mix (N.P.K -11:2:15).

Alternatives to synthetic fertilizers should be pursued. In recent years, a family of alternative agricultural practices aimed at productivity and sustainability of agricultural systems has received. These include green manure with legumes and other similar species, better resting crops, improved rotation systems, and mulching to improve fallow.

Trials have taken place in the humid and sub-humid tropics, Latin America, Africa and Asia. There are also warm and dry Mediterranean climate examples in South Australia, Western Australia and Victoria which may provide understanding of the needs and processes involved for calcareous soils.

(xi) Alternative Cropping and Fallow Management

This section canvasses some alternative land use and management practices for Niue in terms of fertility and soil structure management. Some suggestions may have direct applicability to the problems here and its implementation would be largely a case of awareness and capacity building.

Zinc Deficiency

Work by Ma et al (1996 & 1997) may have implications for land management practices in Niue where most soils are deficient in zinc. They report on the influence of cropping and temperature on the take up of zinc. The proportion of added zinc in the extractable fraction decreased with increasing incubation time and with increasing temperature. Retention of ground litter on plantation areas in preparation and after planting of taro may assist with maintaining lower soil temperatures. Timing of zinc supplement may also need to be considered.

Chemical Imbalances and Deficiencies

Blakemore et al (1979) prospered the idea of using nitrogen fixing legumes to address depleted soils in Niue. The prospects of legumes, mainly lupins, to increase nitrogen availability and maintain soil structure in calcareous soils and means to address the problem of high $CaCO_3$ affects on Fe uptake by legumes have been investigated. The effects of poor aeration of calcareous soils on Fe uptake, which adds further weight to the need to maintain good levels of organic matter in Niue's soils was also considered.

Effluent Re-uses

Re-use of effluent combined with or without composition with non-petruscible waste (to form compost or mulch) is another contemporary technique for sustainable rural land use. This could offer financial savings and improved environmental condition. The leaching of nutrients to the

water lens would need to be controlled and best practice environmental health precautions taken. There are a number of criteria and guidelines available to ensure appropriate disinfection and water, chemical and toxic metal modeling. Of interest to Niue, it was found that calcareous soils had a higher absorption rate of P and slower transmission rate (residence time) than expected. If managed well the calcareous soils of Niue may offer an advantage for land application of effluent.

Reducing Topsoil Ca Levels

High pH levels and Ca values are known to reduce the availability to plants of certain essential elements and nutrients (Leslie, 1985). Effluent while providing a reservoir of nutrients, is high in organic matter and slightly acidic. Leaching of Ca from the soil could be an option for Niue and be caused, by light cultivation and nitrification of soils from legumes or fertilizer, to increase the mobility of Ca. Oversupplies of Mg also could be leached in the same fashion. However given Niue's rainfall, soil porosity and permeability, other valuable micronutrients and essential elements could be washed from the soil (e.g. K and zinc).

Improving Organic Content and Microbial Activity

The importance of microbial activity in the release of nutrients from accumulated soil organic matter is an essential supply of readily useable carbon (C) to provide the energy source for the microbial populations. In Tonga, consideration was given to the problem of short fallow periods, declining nutrient levels and the dominance of guinea grass *(Panicum maximum L.)*. As a result of this, trials conducted, highlighted the potential use of guinea grass as mulch.

Bio-Fertilizers

The use of 'bio-fertilizers' by indigenous groups is recognised, however little is known of the ingredients of some mixtures. Very good results are being obtained from leaf extracts from *Glyricidia sepum* (for N) and *Tithonia* (for P) leaves as foliar sprays. Spraying beans *(Phaseolus vulgaris)* repeatedly with this extract doubled productivity. The effects are two-fold: insecticidal, as well as nutrient provision.

Cover Crops and Green Manure

Traditionally the term "green manure" referred to crops that were incorporated into the soil while green, or soon after flowering, in order to enrich the soil with N. More recently, the term also refers to plants or vegetation, which are applied as mulch to the soil, either while green, or after curing. The two terms were used as far back as 1927. Pieters, stated that "Green manuring is the practice of enriching the soil by turning under un-decomposed plant either in place or brought from a distance." He further stated "A cover crop is one planted for the purpose of covering and protecting the soil." Cover crops are generally any crop grown for soil cover, regardless of whether they are later incorporated. They can refer to crops grown between horticultural trees or in paddocks between cropping seasons to protect against soil erosion, salinisation, acidification or leaching.

Examples of species used as manure and cover crops in South-East Asia include the Rice bean (*V. umbellata*); the "green bean" in Vietnam (known as the "green gram" in India) which does not require fallows; the "tey" bean in Vietnam; and broad-beans or fava beans (*Vicia faba*). Many of these bean crops are grown with or in rotation with maize.

Where phosphorus is the most important limiting factor cassava has been used in a three-year rotation system (Mulch-L (1) (a), 1997). Cassava, which is usually ready for harvesting by the end of the second year, is left for the third year as it reportedly improves soil fertility dramatically to the point where the soils were good enough for rice or soybeans in the fourth year. The improved fertility was in part due to the large volumes of leaf litter from the cassava, but also because of the heavy weed growth associated with the plant. These were found to consist of a large variety of legumes among the grasses. Also, up to 75% of the weed bio-mass in the third-year fields was "epatorium", a weed which is known to access and make available large quantities of phosphorus. Cassava is widely grown in Niue but not extensively as a green manure or cover crop. It is believed to reduce the fertility of soil here during fallow periods (G. Sioneholo, Senior Surveyor and grower, pers comm.) and a wild legume ("cerratus" Niuean) is considered a better fallow plant. P deficiency is not a big concern in Niue whereas N is. While this may explain the observation

made, given its wide use in South East Asia and Central America, it is certainly worth investigating scientifically.

Managed Fallow

Farmers, for the purpose of achieving enhanced ecological efficiency, economic productivity, or some combination, define managed fallows as constituting an intensification of land use management" (Mulch-L (2) (a), 1996). More effective or productive fallows often provide an intermediate step in a transition to permanent cultivation of annual crops.

Managed fallows could incorporate use of many of the above options including green manure or cover crops. Good fallow management could address the pressure for reduced resting periods and help sustain more intensive agricultural practices, while conserving the natural resource base, particularly the soil. The results could be the increase in sources of nitrogen (N), improved soil structure and fertility, increased biological activity, while controlling pests and weeds. Fallow crops could also be additional sources of food, feed and fuel for subsistence families.

3.0.5.3 Have specific plans or strategies been developed in the past to address desertification?

Two specific plans and strategies have been developed, however more recently, to address desertification.

These include:

(a) 1992 Forestry Plantation Project: Aimed at replenishing depleted soil areas via agro-forestry. Unfortunately this project was not successful, largely due to poor growth of exotic species chosen, land tenure conflict and heavy reliance on overseas subsidisation. (Previously reported in (vii) Responses and Their Effectiveness)

(b) Development of a Basic Land Capability Model: this was an output of the LMRUP, and enables various soil types and land areas to be rated on the basis of 18 fields of data such as soil depth, soil type, zinc deficiency and best crops for that particular area. This then establishes a 'suitability criteria' for land use. (Previously reported in *Land Evaluation and Appraisal*)

3.0.6 Institutional Framework

Institutional Framework For Coherent and Functional Desertification Control.

3.0.6.1 Have the mechanisms available for coordination and harmonization of actions to combat land degradation at national and local levels, been reviewed or analyzed?

The Land and Marine Resource Use Plan 2000 has addressed land degradation to some extent, however specific plans directed at land degradation, have not been initialized. It is important to note however that there are several action plans specifically, Climate Change and Biodiversity that address many land degradation issues as they are closely linked.

3.0.6.2 Has the review led to any proposals or new political, institutional or organisational measures?

Further land degradation by the proposal of new development is addressed under the Land Use guidelines. However this is targeted at development that will be assessed before it is approved, under various environmental tools (e.g. EIA, EIS). It is important to note that this does not include land cleared for taro cultivation, which is one of the major causes of land degradation, due to clearance methods, exposure of soil and chemical applications.

Remedial measures have not been pursued for land already degraded.

3.0.6.3 What are the measures taken to make the above measures sustainable and effective?

At this point in time no specific measures have been addressed to change the rights of people to use their land as they please. However, legislation is to be passed to add to the stature of recommendations to avoid land degradation.

3.0.6.4 Has capacity and institution building been addressed and promoted?

Only to a small extent. Government anticipates technical assistance for UNCCD projects.

3.0.7 Status of Information Data

3.0.7.1 What other databases exist in the country which are relevant to desertification?

The GIS held at the Department of Justice, Lands and Survey. This houses information gathered by community consultation in addition to scientific input. A limited Land Capability model has been produced.

There is room for improvement in the management and dissemination of such data.

3.0.8 Coherent and Functional Legal and Regulatory Framework.

3.0.8.1 Has a study or analysis been made on existing legislation?

Some work has been done in this area, but has yet to be completed. The Governments of Niue and New Zealand have identified the need and a response is currently being formulated.

3.0.8.2 What have been the legislative measures that aimed at developing and ensuring a greater involvement and responsibility of local populations?

Most if not all of the documents set to the gazette planning guidelines, involved extensive consultation with local communities. The planning process itself includes the need to consult local communities in order for their concerns to be addressed in the approval of development. This step allows not only their concerns to be raised but the awareness of certain impacts that are not as obvious.

3.0.8.3 Have measures been taken to raise awareness and encourage local populations to enhance their participation?

Yes. National workshops are held to consult communities and raise awareness in nearly every major resource use. This is particularly so for issues involving land use.

Other institutions include:

- Disaster Council
- Fire Rescue Service
- Environment Sections

3.0.8.4 Have measures been taken to strengthen capacity of local populations and local authorities to participate in decision making that is relevant to combating land degradation?

Yes. However, there is room for more awareness with regard to traditional practices versus conventional methods for land clearance. Also the trade off between different land uses, economically and traditionally, in the short and long term. Furthermore there is a need to strengthen the capacity in schools at the primary and secondary level.

3.0.8.5 What are procedures to identify and implement such measures?

When funding is made available through regional projects, measures such as awareness campaigns and literature reviews are initiated. Without external funding, local government budgets are insufficient to address issues such as land degradation.

3.0.9 NAPs as Part of the National Economic and Social Development and Environment Protection Plans.

3.0.9.1 Has a concerted analysis been made on the existing plans and strategies that are relevant to combating land degradation with the purpose of ensuring complementary action and avoiding duplication or scattered efforts?

No

3.0.9.2 How are the UNCCD principles acknowledged and integrated in other environmental and development plans (participation, partnerships, programme approach etc)?

They have not been integrated or acknowledged as yet.

3.0.10 Established Technical Programs and Functional Integrated Projects to Combat Desertification.

3.0.10.1 What new actions are proposed to combat desertification?

- Organic is a favorable option in place of conventional agricultural methods.
- Lupin planting in disc ploughed areas.
- Introduction of relevant legislation.

3.1.1 What Are The Planned Measures?

The Niue National Biodiversity Strategy and Action Plan (2001), identifies actions to help counter desertification. The relevant actions are stated as follows:

3.1.1.1 Conservation and Sustainable Management of Terrestrial Habitats

This covers the management of land, whether it is for agricultural purposes or forest conservation. The existing patterns of land use are based on a number of factors including soil fertility, makatea outcropping, land clearing and agricultural practices, types of crops and land ownership. Measuring land use is difficult due to lack of maps,

coordinated land information and the patchwork nature of areas used for cropping. Several authors have referred to the fact that sufficient areas of forest should now have been cleared for agricultural use, so that no further primary forest need be felled for this purpose. A key challenge is to then make more economic sustainable use of cleared lands.

Changing land-use practices are evident in the fact that 80% of households use bulldozers to clear land and 87% use herbicides, mainly paraquat, at a rate of 5-10 litres/month/household (DAFF, 1998b).

The conservation of Niue's terrestrial biodiversity depends on the protection and sustainable use of its different forest habitats. The strategy seeks to ensure this through the continued development of the Huvalu Forest Conservation Area and by the conservation of other forest areas in village Local Area Plans.

3.1.1.2 Sustainable Management of Cleared Lands For Agricultural and Other Purposes

This objective covers the sustainable management of areas in which the primary forest has already been felled. Such areas should be managed sustainably for agriculture or allowed to revert back eventually to primary forest. Actions cover the management of soils, the methods used to clear land and the use of chemicals, and sustaining their agricultural productivity.

Action 1: Develop a Code of Practice for land clearance using best practice including the following, and provide necessary training:

- Restricting D9 bulldozers to public infrastructure work or land clearance in previous fallow areas. (This would serve to protect areas of primary forest, which D6's are not capable of clearing).
- Ensure that operators keep their bulldozers away from reserve land, burials, historical sites, and traditional forts.
- Ensure that bulldozer operators are made aware of which trees are useful food sources for wildlife and which are used as boundary markers between landowners.
- Ensure that bulldozer operators leave a litter layer and do not disturb the soil.
- Discourage or ban the use of fire to clear land.

Action 2: Undertake research to identify new crops suitable for Niue that will make sustainable use of cleared land.

Responsible Government Departments ensuring implementation of the above stated action(s): PWD, DAFF, Bulldozer Operators, Landowners, DJLS.

CHAPTER 4

4.0 Conclusion

Notwithstanding problems with tenure and socio-economic pressures, there are physical land management practice choices available that could ensure the future sustainable use of Niue's soil resources. The alternatives will need careful consideration and many may require scientific and economic feasibility studies. Some have been practiced by a few landowners in Niue and their greater acceptance by the community may come from awareness and simple capacity building efforts.

On reflection there are pertinent policy (legal and others addressing the problem of attitude) and physical land practice changes needed to ensure the future sustainable use of Niue's soil and forest resources. Considering alternative tenure systems is beyond the scope of this paper but its importance and necessary attitude changes relative to it, and links it has to many socio-economic, socio-cultural and physical practice factors have been discussed. Land tenure is so inextricably linked to natural resource management in Niue, that to suggest changes to physical land practices only, as a means for sustainable use, would be wrong.

Notwithstanding problems with tenure, another key to significant improvements improving theory land is used and managed in Niue is the provision of information to the community. Scientific information on the physical and chemical properties of the soil families, or the diversity of forests is useful. However the evaluation and analysis of this data needs to culminate in a communication platform which is better understood by the community and allows rational decision making. This has been the intention of the LMRUP in developing the limited soil suitability database and mapping.

4.0.1 Further Work Which Would Be Beneficial in the Following Areas.

- GIS development of a land capability/suitability rating system, which is adapted/adopted to suit Niue's, unique soils and associated biophysical resources.
- Pre-feasibility and feasibility work on the beneficial use of effluent for production of alternative fertilizers, topsoil's, or mulch.
- Pre-feasibility work would entail initial field and desk surveys to quantify the resource components, ie:
    - volumes of pumped out effluent;
    - volumes of synthetic fertilizer imported;
    - potential demand;
    - vegetation litter availability;
    - ratio mix of makatea, vegetation litter and effluent;
    - best practices for pathogen, leachate and application management
- Feasibility studies would be more detailed and include technical inputs such as:

- field permeability test
- water
- nutrient and toxin balance modeling
- cost-benefit-analysis
- field trials etc.

♦ Studies on the practical methods available for low-cost soil rejuvenation of 'fern-lands' especially those areas that have experienced repeated disc ploughing.

- agroforestry with native tree species observed to flourish in poor soils
- use of nitrogen fixing legumes
- long fallow periods inclusive of the use of green manure and/or cover crops

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