National Action Plan

Addressing Land Degradation and Drought

Compiled by Felicia A Nemaia

Niue's National Action Plan Addressing Land Degradation and the Effects of Drought under the Auspices of the Secretariat of the United Nations Convention to Combat Desertification

2004

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ACRONYMS

AusAID	Australian Agency for International Development
CBD	Convention on Biological Diversity
CCD	Convention for Combating Desertification
DAFF	Department of Agriculture, Forestry and Fisheries
DJLS	Department of Justice, Lands and Survey
DSAP	Development of Sustainable Agricultural Practises
DSIR	Division of Scientific and Industrial Research
EEZ	Economic Exclusive Zone
EIA	Environment Impact Assessment
ENSO	El Nino Southern Oscillation
FAO	Food and Agriculture Organisation of the United Nations
GIS	Geographic Information Systems
GMO	Genetically Modified Organisms
GPS	Geographic Positioning Systems
GTZ	German Technical Assistance
HIES	Household Income and Expenditure Survey
LMRUP	Land and Marine Resource Unit Plan
LDC	Least Developed Countries
MFN	Moui Faka Niue
NAP	National Action Plan
NBSAP	National Biodiversity Strategy and Action Plan
NCSA	National Capacity Needs Self Assessment
NEMS	National Environmental Management Strategy
NZODA	New Zealand Overseas Development Agency
PIC	Pacific Island Countries
PWD	Public Works Department
SIDS	Small Island Developing States
SOE	State of the Environment
SOPAC	South Pacific Applied Geoscience Comission
SPC	Secretariat of the Pacific Community
SPOT	Satellite Earth Observation System
SPREP	South Pacific Regional Environmental Programme
TPN	Thematic Programme Network
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations Framework Convention for Climate Change
UNV	United Nations Volunteer
VSA	Voluntary Services Abroad
WSSD	World Summit on Sustainable Development

GLOSSARY: NIUEAN WORDS

leviki magafoa	Trustee(s)/guardian(s) of the land on behalf of all members of the family with an interest in the land
leviki	caretaker
lupe	Pacific pigeon
magafoa	extended family
makatea	fine granulated rocks originating from calcium carbonate parent material
Moui Faka Niue	Niue way of life
palau	bush garden /plantation
peka	fruit bat

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- Department of Justice, Lands and Surveys' staff
- Public Works Department
- Water Supply Division
- Niue Island Organic Farming Association (NIOFA)
- Private Sector Growers
- Mrs Tina Cooper, Repertoire

1.0 INTRODUCTION

The global impacts of desertification and land degradation prompted the United Nations Organization to adopt the United Nations Convention to Combat Desertification (CCD) in 1994. Niue acceded to the UNCCD on 12 August 1998 and entered into force on 10 November 1998. Under the CCD all parties to the Convention are expected to prepare and implement a National Action Programme (NAP).

The people of Niue are attuned to critical environmental issues, more so than those who live in larger developed countries as they are able to insulate themselves and therefore delay resolving such issues.[1] This is not the case for small island nations and developing countries whose population are directly dependent on the environment to provide the majority of their essential needs and their nation's potential to economic development through sustainable primary trade and tourism.

Land is one of Niue's basic fundamental resources and therefore needs to be protected, enhanced and properly managed if the best results are to be gained from it, and if it is to be maintained for use by future generations. This is reflected as one of Niue's strategic objectives in its Integrated Strategic Plan 2003 -2008; *"Sustainable Management of Niue's Resources for Future Generations*."

Land degradation in Niue has been recognized and well documented and has been particularly prevalent over the previous 30 years where there has been substantial deforestation despite a declining population. This in turn has lead to an increasing emergence of environmental problems relating to land and forest uses and include increased land clearing and deforestation, increased reliance of synthetic fertilizers and pesticides, reduced fallow and its impact on soil depletion and the reduction in population of local wildlife.

It is also important to note that land tenure within Niue is interlinked with socio-cultural, socio-economic and physical practice factors which must be taken into consideration when addressing sustainable land use and agricultural development practices.[3]

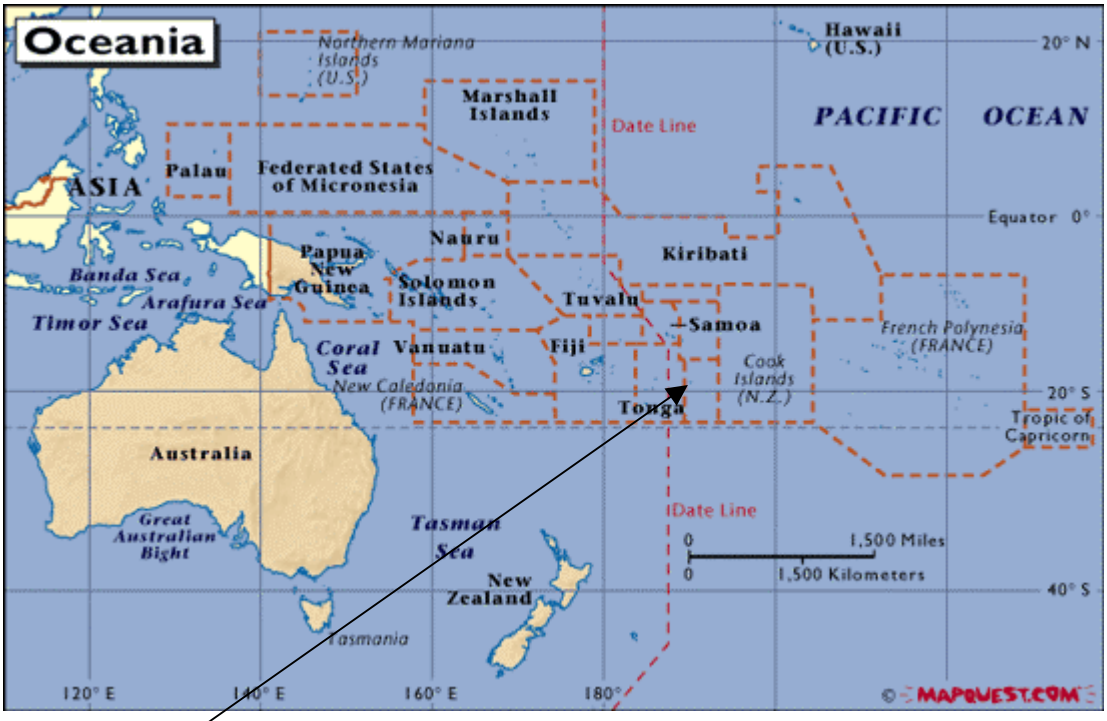
The development of any national programme must involve the entire nation as it seeks to address a national issue. Fortunately this is not difficult for Niue, as it has a small but "environmentally aware" population base amongst which land degradation and drought mitigation are issues in which every Niuean has a stake.

The action plan formulated and information presented are largely drawn from previous environmental reports and recommendations, which relate to land degradation and/or drought mitigation measures. Care was exercised in order for the action plan to be a realistic and achievable working document.

2.0 OVERVIEW OF NIUE

2.1 Geophysical Characteristics

2.1.1 Geography



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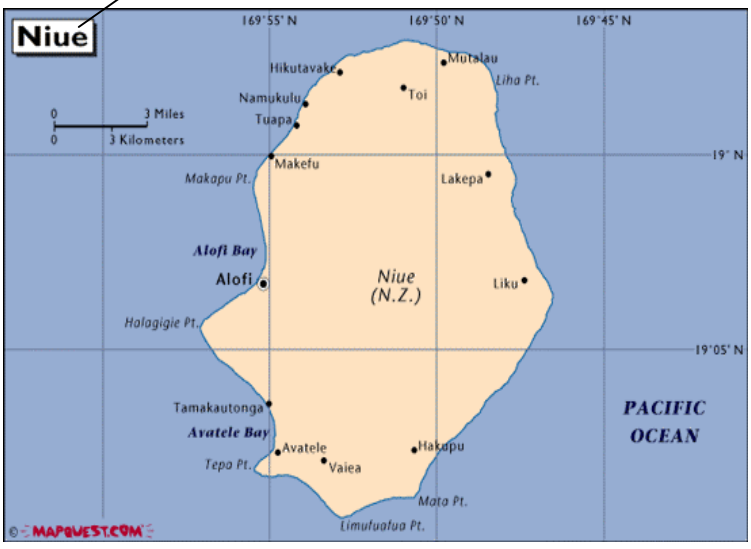


Niue is part of Polynesia and is situated in the Southwest Pacific Ocean at latitude 19° south and 169° west. Niue lies approximately 480 km east of Tonga, 930 km west of Rarotonga, Cook Islands, 660 km south east of Samoa and 2,400 km north east of Auckland, New Zealand.

The land area of Niue amasses to 259km^2, with an Exclusive Economic Zone (EEZ) of 39,000km^2 of the South Pacific Ocean

2.1.2 Geomorphology/Topography

Niue is the world's largest single raised coral atoll, which emerged in stages out of the ocean. Two theories have been put forward explaining how Niue was formed. One being that Niue was formed due to forces from internal volcanic activity, as in some areas there is a thin layer of ash that is the cause of locally high radioactivity. The other theory is that the uplifting was due to the buckling of the Pacific tectonic plate prior to its subduction into the Tongan trench, evidence being Niue's characteristic chasms[1].

Niue rests on a seamount with the surrounding ocean depths reaching up to 4000m. The island comprises of three terraces, the lower terrace rim averages 28m above sea level, with the upper terrace rim averaging 69m above sea level. The three distinct terraces imply that Niue was uplifted out of the ocean in stages.

The centre of the island comprises of a hollow, thought to be the remnants of a lagoon as a result of being raised up out of the ocean in stages.

Niue's parent rock is coral limestone. Its landscape is rough comprising of jagged coral rocks, boulders and many crevices and holes. The coastline is also rugged and rocky, featuring steep cliffs, caves, chasms and blow holes.[1]

There is no inland running water on Niue such as streams or rivers. Rainfall filters through the thin topsoil layer, down the cracks/cavities in the base rock. A permanent fresh water table is located approximately 60m below the rim of the central plateau, evidence of a body of fresh water above sea level. Caves occurring around the island host brackish pools of water whereas caves found in the centre of the island have fresh pools of water.[2]

The freshwater lens below the island is the main source of water and is tapped for domestic and agricultural purposes via a number of atesian bores.

2.1.3 Climate

Niue lies on the edge of the southern tropical cyclone belt and in the zone of the southeast trade winds, and is subject to strong gale force winds, noticeably through the months of April to October. It also is prone to the devastating effects of cyclones. Significant damaging cyclones have occurred on average once every 10 years, the most recent being, cyclone Heta, 5 January 2004, classed as a Category 5 on the Saffir-Simpson Scale, the worst in living memory with winds of up to 300kph, claiming two lives and causing overwhelming devastation to Niue's biodiversity, forestry/agriculture and infrastructure.

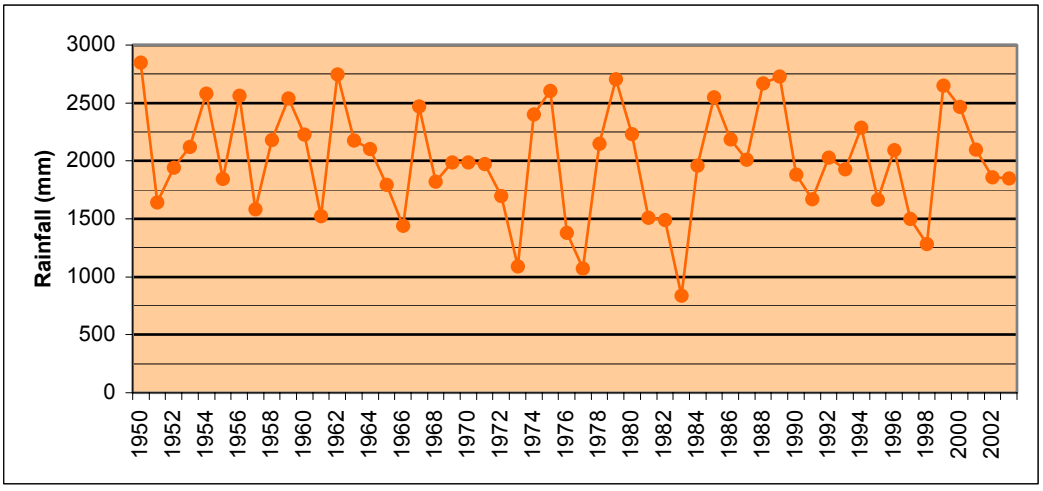
[1] 1993, Niue State of the Environment Report, SPREP
[2] Niue Environment Department 2001, Niue National Biodiversity Strategy and Action Plan

SAFFIR-SIMPSON SCALE				
Scale No.	**Central Pressure**	**Winds**	**Surge**	**Damage**
1	>28.94" (980 mb)	74-95 mph (119-153 km/hr)	4-5 ft (1.2-1.7 m)	Minimal
2	28.91-28.50" (979-965 mb)	96-110 mph (154-177 km/hr)	6-8 ft (1.8-2.6 m)	Moderate
3	28.47-27.91" (964-945 mb)	111-130 mph (178-209 km/hr)	9-12 ft (2.7-3.9 m)	Extensive
4	27.88-27.17" (944-920 mb)	131-155 mph (210-249 km/hr)	13-18 ft (4-5.5 m)	Extreme
Super Typhoon		>150 mph (241 km/hr)		Catastrophic
5	<27.17" (920 mb)	>155 mph (249 km/hr)	>18 ft (5.5 m)	Catastrophic

Table 2.1 Saffir-Simpson Scale of Cyclone/Hurricane Damage

There are two distinct seasons, a hot wet season from November to March, characterized by high temperatures and humidity, which coincides with the cyclone season. The cooler dry season is from April to October, characterized by warm sunny days, cool nights and strong breezes.

Annual average temperature does not fluctuate greatly throughout the year, largely due to the influence of the sea on a small island. However at the height of the wet season mean daily maximum temperature is 30°C (Jan/Feb) with a mean daily minimum of 23°C. In the dry season (Jul/Aug) the mean daily maximum is 26°C and a mean daily minimum of 19°C.[3]



[3] 2002, Niue's National Report on the Implementation of the United Nations Convention to Combat Desertification.

Figure 2.1 Niue: Average Annual Rainfall Distribution (Alofi)

Average annual rainfall is approximately 2,070 mm with a significant proportion of the rainfall concentrated in the wet season (Jan-Mar) in the form of torrential downpours, the drier months are in July-Aug.[4]

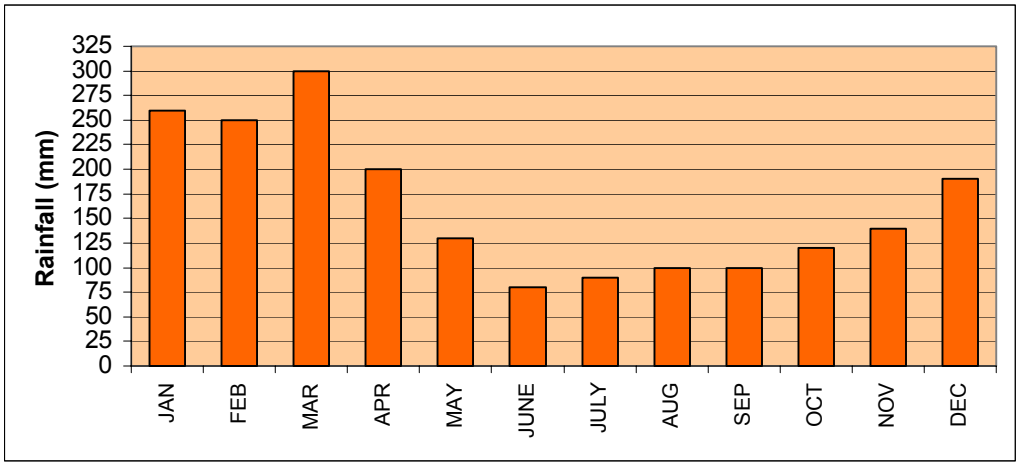


Figure 2.2 Niue: Average Monthly Rainfall Distribution (Alofi) [4]

Years on Record: 86

2.1.5 Biodiversity[2,5]

Due to it's geographic isolation Niue has naturally limited occurring flora and fauna. This has also worked to its advantage with a relatively limited number of introduced species to Niue, until recently.

Three species, classified as vulnerable are the Pacific pigeon, *Ducula pacifica*, fruit bat, *Pteropus tonganus* and the coconut crab *Birgus latro*. Their vulnerability is a result of over harvesting and the effects of cyclones.

[4] Quikcast.com Weather Forecast.
[5] Hay, R & Powlesland, 1998. Guide to the Birds of Niue. South Pacific Regional Environment Programme, Apia, Samoa.

Table 2.2	Summary Of Niue's Terrestrial Biodiversity[2,6]	
Flora	629 taxa of a variety of vascular species of flora. Including an estimated 175 indigenous species + a few cultivars[6]	
Vegetation		
1. Mature Forest : High closed canopy	*Sysygium richii, S. inophylloides, Dysoxylum forsteri, Planchonella torricellensis, Pometia pinnata, Macaranga seemanii*	
2. Coastal Forest	As above but largely dominated by *Barringtonia asiatica*, salt resistant tree	
3. Secondary Canopy	*Hibiscus tiliaceous, Baccaurea seemanii*	Constitute the 'poineer species"
4. Managed Land	*Hibiscus tiliaceous, Morinda citrifolia, Macaranga harveyanna*	If left to fallow for a period of 4-10 years
	Ferns, *Nephrolepis hirsutula*	As a result of overcropping
Native Land Mammal	Tongan Flying Foxe/peka: *Pteropus tonganus*	Endangered. Vital to the survival of some native trees, as are the only species to pollinate them. Important for the regeneration of the forests via dispersal of fruits/seeds. Also a delicacy among Niueans
Introduced Land Mammals	Polynesian rat, *Rattus exulans* Ship rat, *Rattus rattus,* House mouse*, Mus musculus*	Not including the introduction of cats, dogs, pigs, and cattle.
Reptiles	5 species of lizard, 2 gecko's and 3 skinks	
Invertebrates	376 Insect species in 15 orders	4 species of fruitfly identified, 3 of which are considered pests of economic importance. *Bactocera passiflorae, B. kiriki, B. zanthodes*
Birds	31 bird species recorded. 6 seabirds, 10 shorebirds and 15 landbirds.	2 endemic subspecies: Polynesian triller *Lalage maculosa whitmeei* , Polynesian starling, *Aplonis tabuensis brunnescens.* Landbirds also form a crucial link in the regeneration of the native forests through the dispersal of seeds. Not including the introduction of the feral fowl, *Gallus gallus*, also present.
Landcrabs	8 known species	Coconut crab, *Birgus latro* is the largest and an important traditional food source.

[6] Sykes, W R 1970, Contributions to the Flora of Niue. DSIR Bulletin 200, Christchurch, New Zealand

2.2 Socioeconomic Characteristics

2.2.1 History

The indigenous Niuean people are of Polynesian descent and are thought to originate from the neighbouring islands of Tonga, Samoa and Pukapuka Island of the Cook Islands, as all share strong cultural and language similarities.

It is speculated that Niue was settled over 1000 years ago by the Polynesians, however recorded history of Niue dates from the mid 18th Century. First recorded European discovery of Niue was by Captain Cook in 1774 but was received with such ferocious hostility that he named it "Savage Islands". This reputation is thought to account for the infrequent contact from the outside world during that period.

Outside contact was firmly established in the mid 18th Century, through the establishment of European missionaries. Niue became a British protectorate on 21 April 1900, and the following year was annexed to New Zealand. Niue was then governed by a succession of Resident Commissioners until 1974 where Niue became a self-governing nation in free association with New Zealand, which still remains to date.

2.2.2 Governance

As the smallest self governing nation, Niue's governance is based on the Westminster parliamentary system. In essence Niue has a legislative assembly comprising of 20 members, whereby individual villages elect 14 and the remaining 6 are elected by a common vote.

The legislative assembly elects a Premier, who in turn selects three ministers. The Premier and the three ministers comprise the Cabinet. Elections are held every 3 years.

2.2.3 Population and Welfare

In contrast to many developing countries, Niue has a declining population mainly due to emigration to New Zealand and Australia. The population has steadily declined from 5,296 in 1969[2] to 1707 in 2002[7]. Prior to 1969 the population was relatively stable fluctuating between 4,000 and 5,000. A number of governmental measures have been put in place to counteract this trend, with limited success.

Niue has a high literacy rate of 99% with free access to primary and secondary schools. The education curriculum is based on the New Zealand system. Attendance at school is mandatory until 14 years of age. There is also a satellite University of the South Pacific, for the academically inclined students, catering for diploma and the first two years for degree level students.

Prior to cyclone Heta, Niue had a modern well equipped hospital, with free medical and dental care available to all Niueans and permanent residents. Currently Niue is negotiating with various aid agencies for a downscaled version of the original hospital on a site deemed low risk from the effects of a cyclone and resultant oceanic wave surges.

[7] 2003-2008, Niue Integrated Strategic Plan, Government of Niue

2.2.4 Economy

Gross Domestic Product for Niue was for the 2002 was $14.2 M[8] of which New Zealand Overseas Development Aid accounts for $6.25M[9], the remainder is sourced via Australia Aid, International Business Company Registrations, currently under review due to international pressure, and until recently the allocation of fishing licenses to fish within Niue's EEZ.

Niue's strategic integrated plan identified tourism, agriculture and fisheries as industries that have a comparative advantage and are therefore targeted as key initiatives.

Tourism brings in an average of 1145[10] tourists/visitors per annum, which is well under that of the State of the Environment (SOE)[1] report that reflected over time there would be an anticipated 5,000 to 20,000 visitors/tourists per annum. Niue is marketed as a "soft adventure destination" mainly in New Zealand and Australia. The tourism focus is ecotourism and enhancement of cultural viability through the promotion and preservation of the Niuean lifestyle and includes activities such as diving, fishing, and forest walks.

The major export commodity is taro and honey with small quantities of coconut, handicrafts and vanilla also exported. Historically exports have also included banana, kumara, cassava, passionfruit, and limes.

Cyclone Heta significantly impacted Niue's economy with an overall estimated damage of NZ $89.1M (US$60M). Damage was sustained to properties, agriculture, government and industry infrastructure. Damaged properties are still evident in many parts of Niue and it is anticipated that full recovery is not expected for several years.

Recently the Government of Niue has entered into two substantial ventures, with a potential to significantly boost Niue's economy. One is the development of a fish processing and storage facility and is a joint venture between an overseas company and the Government. It is anticipated that up to 20 fishing boats will be fishing in Niue's EEZ and will be constrained to process their fish through Niue's fish processing plant for both the local and export markets.

8 2003 – 2008, Niue's Integrated Strategic Plan
[9] 2004, Pacific Regional Energy Assessment, Niue National Report, SPREP
[10] Immigration Satistics for 2000 - 2003

Establishment of a Large Scale Organic Nonu Plantation

The second joint venture also involves the same parties and consists of a large-scale nonu plantation and nonu juice processing facility. The venture aims to export organically certified nonu juice to major export markets, including New Zealand. The plant aims to accommodate all nonu growers through the purchase of nonu for processing.

3.0 RATIONALE FOR NIUE'S COMMITMENT TO UNCCD

Situated in the Southern Pacific Ocean, Niue does not conjure images of arid nor semi-arid landscapes. However, as a single upraised coral atoll, Niue has fragile soils with limited soil fertility and degraded areas as a result of deforestation and agricultural practices. It therefore follows that Niue along with 13 island nations in the South Pacific acceded to the United Nations Convention to Combat Desertification (UNCCD), in recognition of the magnitude of environmental and socio-economic impacts of desertification, land degradation and drought.

Issues pertinent to Niue are those of land degradation, drought and sustainable land management, rather than desertification in itself. These are issues that all developing countries need to address whilst at the same time trying to raise their socio-economic status.

Serious droughts have been experienced in the South Pacific Island countries due to the El Niño and La Niña phenomena. And as of late El Niño conditions have been predicted to occur within the next three months.[11]

Niue acceded to the UNCCD on 12 August 1998 which entered into force on 10 November 1998.

The Convention to Combat Desertification (CCD) promoted regional cooperation to combat desertification and mitigate the effects of drought. The CCD Regional Action Programme for Asia (including the Pacific) was developed, and comprised of 6 thematic programmes. Of the six thematic programme networks (TPN), three were of particular relevance to Niue.

1. Network on desertification monitoring and assessment (TPN 1)
2. Network on agroforestry and soil conservation (TPN 2)
3. Network on capacity building for drought mitigation (TPN 5)

[11] National Weather Centre, Climate Prediction Service, 5 August 2004.

4.0 COMMITMENTS TO ENVIRONMENTAL INTERNATIONAL CONVENTIONS

Though small in stature, Niue is actively committed to a number of conventions that advocate for the protection of the global environment and can be found listed in the following table.

Due to the small population of Niue, public awareness campaigns are effective and far reaching with the overall population becoming aware of Environmental Conventions and its implications such as the Convention of Climate Change, International Waters Project, Convention on Biological Diversity, Persistent Organic Pollutants in Pacific Island Countries, to name a few. These are often integrated in some form into the school curricular activities, which is a positive step for the future of Niue's unique environment and its sustainable use.

Table 4.1 Niue's Commitment to International Environmental Conventions and Regional Environmental Treaties

Convention	Date Signed	Focal Department
Convention for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean, 2000	Signed 30 Oct 2000 Ratified 17 Dec 2003	Department of Agriculture, Forestry and Fisheries
Convention for the Prohibition of Fishing with Long Driftnets in the South Pacific, 1989, Wellington (Wellington Convention)	Ratified April 1997	Department of Agriculture, Forestry and Fisheries
Convention for the Protection of Natural Resources and Environment of the South Pacific Region, 1986 Noumea (SPREP Convention)	Ratified 3 May 1990	Department of Environment
South Pacific Nuclear Free Zone Treaty, Rarotonga, 1985	Signed 12 May 1986	Office for External Affairs
Stockholm Convention on Persistent Organic Pollutants	Ratified 12 Mar 2002	Department of Environment
Treaty on Fisheries Between the Governments of Certain Pacific Island States and the Government of the USA, 1987, Port Moresby	Ratified 28 Mar 2003 (10 year extension)	Department of Agriculture, Forestry and Fisheries
UN Convention on Biological Diversity (CBD) 1992 Biosafety Protocol	Ratified 27 Feb 1996 Ratified 3 Jul 2002	Department of Environment
UN Framework Convention on Climate Change (UNFCCC) 1992 Kyoto Protocol	Ratified 27 Feb 1996 Ratified 6 May 1999	Meteorological Services
United Nations Convention on the Law of the Sea, 1982	Signed 1984 Acceded Sept 2003	Attorney General's Office
Vienna Convention for the Protection of the Ozone Layer 1985	New Zealand signed on Niue's behalf.	Department of Environment
Waigani Convention	Ratified 2003	Department of Environment
World Heritage Convention, 1972	Ratified 21 Dec 2000	Department of Community Affairs

5.0 LAND USE AND TENURE

5.1 Land Tenure[8, 9]

In essence there are two types of land tenure in Niue. Crown land, which is land, vested to the Crown through acquisition by the government. Niuean land owned by Niueans and is legally vested in the Crown but held by the traditional owners.

Land tenure in Niue is held under traditional customary ownership on the basis of the usehold system. Traditionally every member of the society had ties with certain land, which he or she had acquired at birth via blood or familial connections. Land is the fundamental basis of Niuean culture and society.

With extensive inheritance systems of land, over time, more and more individuals and families will have a genealogical connection to the land. Therefore over time conflicts over the use and ownership of land will rise. Where land is disputed and goes before the court there is a tendency to base decisions on genealogy. The resolution is sometimes the distribution of a share of the land amongst many parties. The land therefore becomes fragmented and cannot support sustainable development or economic investment. The alienation restrictions do protect the Niuean culture from the dominance of externals. However it also results in a system where there are no land consolidation or redistribution mechanisms – a necessary tool for economic and sustainable development.

Land cannot be alienated in Niue under present land laws other than by transferring the land to the Crown, leasing the land or by security charge.

5.2 Landuse[9]

Agriculture remains the most important land-use on Niue and is a major economic activity in Niue with the majority of households dependent on agriculture for subsistence. A Household Income and Expenditure Survey (HIES)[12] conducted in 2002 concluded that the major primary source of household income was that of wages/salaries (55.3%) with the second largest (12%) source of income was produced by the households themselves.

Landcare Research SPOT imagery maps approximated that 20% of land in Niue is non-forested land used for village settlements and agricultural production (which includes fallow agricultural land and degraded cleared areas).

	Land Use Area (ha)
Taro	613.0
Coconuts	290.0
Kava	49.0
Nonu	65.0
Tapioca	5.6
Vanilla	3.7
Total Land Area	1026.3

Rotational or shifting agriculture is practiced on Niue with taro (*Colocasia esculenta*) as the primary crop. Main crops grown in addition to taro are banana, paw paw, tapioca (cassava), coconuts, breadfruit, kumara (sweet potato), yam, limes and garden vegetables.

Table 5.1: Cropping Land Use (ha) in Niue[13]

[12] 2002, Household and Income Expenditure Survey, Department of Statistics, Government of Niue
[13] 2001 Census, Department of Statistics

5.3 Settlement Patterns[14]

Human settlement patterns in Niue follow two broad categories. One is the pattern of settlement about the island, where villages are located along the coastal circular road. The other is the settlement within the village and includes scattered land use about the village, strip development along the coastline (sprawl), and the efficiency and character of various land use.

Currently Niue is undergoing a shift from coastal settlement as a result of the devastation impacted by cyclone Heta, with inland settlement onto the second terrace. This in turn may lead to an increased risk of potential contamination of the water lens. During normal climatic conditions, the water table constantly flushes itself by draining into the sea, however there may not be the same degree of flushing, of the inland settlements as compared to coastal settlements

Within each village there are a relatively large number of abandoned houses of which 26% are structurally unsafe for living (Statistics, 1993). Questions of demolishing these buildings for environmental health and aesthetic reasons have often risen. However the retention of physical structures over land does signify a continued association or involvement with that land parcel. A program to demolish only the walls and roofs of the unsafe buildings, may ensure that there is still a means of identifying a physical structure over the land.[12]

A number of Sustainable Development Guidelines, have been produced to guide future land use and resource use decision-making, and include:

- Sustainable Development Guidelines for Village Planning which aims to promote methodology for the planning of the physical structure of villages and the strategic allocation of "preferred use areas"
- Sustainable Development Guidelines for Tourism Development to assess the physical and environmental implications on development.
- Environment Land Use Allocation and Planning
- Guidelines on the Content and Processing of Environmental Impact Assessments

The GIS mapping system at the DJLS has been developed to a point where better geographic and land use information can be presented to communities but ongoing capacity training is essential to further develop and update the land capability/suitability model. Proposals have been developed for a larger server-based computer set-up with geographically-based database of all information relating to land that will be networked both internally and externally. [17]

[14] 2000, Environment Land Use Allocation and Planning, Land and Marine Resource Unit Planning Project, DJLS.

6.0 STATUS OF LAND DEGRADATION IN NIUE AND ITS CAUSES

Land degradation is defined in Article 1 (f) of the UNCCD as "*reduction or loss, in arid, semi-arid and dry sub-humid areas, of the biological or economic productivity and complexity of rain fed cropland, irrigated cropland, or range, pasture, forest and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns, such as:*

(i) Soil erosion caused by wind and/or water;
(ii) Deterioration of the physical, chemical and biological or economic properties of soil; and
(iii) Long-term loss of natural vegetation"

Due to the landform and soil conditions agricultural opportunities are limited to approximately 60% of land of Niue, even if managed in a sustainable manner. A further factor limiting agricultural production is the lack of running water on the island and the absence irrigation.

However the agricultural potential is reasonable if managed well and not subject to unsuitable cultivation. The majority of the more fertile land is found to the north of the island, whereas the land towards the southern part has been subjected to extensive clearing, cultivation and soil depletion. These areas of extensive soil depletion are called fernlands (or desert areas). [8]

Typical Representation of the Degraded Fernland Areas of Niue

These degraded areas can be largely attributed to the fragile soils, deforestation/land clearance, and agricultural practices.

6.1 Soils

The primary soil related problems are soil fertility, soil depth or lack of it, 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 herbicide in lieu of manual clearing and mulching techniques have all exacerbated these problems.[2]

Generally Niuean soils are poor due to the minimal depth to baserock, makatea outcrops and surface boulders. Characteristics of Niue soils include rock outcrops covering 10 – 60% of land surface, low water holding capacity, moderately to highly alkaline ph, high phosphorous retention, abundance of calcium and magnesium, zinc deficiency varying from moderate to high and low to very low potassium reserves.[15]

The most commonly found soils are the Foa series and the Palai seris and form 30% of the soils of Niue. *Refer Appendix I*.

Observations by Martel *et al* 1997[16], noted that the majority of deforestation from 1966 to 1981 occurred on Foa soils than any other soil type. In addition 42% of Toi soils and 31% of Niufela soils were also cleared. Fonakula was the only other soil type associated with deforestation. All these soils were observed to be deep and/or overly lagoon sediments.
Very little deforestation occurred on thin soils (Hikutavake and Fetiki soils) and on soils with a large proportion of coral outcrops (Palai) as these soils are deemed unsuitable for agriculture.

6.2 Deforestation/Land Clearance[13,2]

The expansion of agriculture is generally one of the chief causes of deforestation, and is accurate for Niue, where the key agricultural activity is the growing of taro for export.

Prior to the 1950s evidence suggest that Niue was well forested, with up to 90% forest cover. Recent comparative studies using forest cover maps revealed the primary and regenerating forests have been reduced by 30% from 1966 to 1994, with the greatest percentage reduction occurring from 1981 to 1994. This intensified period of deforestation occurred at a time where Niue was undergoing its most rapid depopulation.

Therefore the increased rate of deforestation on Niue can not be directly attributed to increasing population pressure but rather socioeconomic factors and cultural values, which in turn leads to land fragmentation, improved land clearance technologies; larger areas cleared, intensive agricultural practices; monocropping of taro for export, and increased use of agricultural chemicals; fertilizer /herbicides and in some cases accidental burning.

Taro Crop: Note patches of poor plant growth indicating nutrient deficiencies within the soil, commonly found throughout fernland areas

[15] 1998, DAFF, Niue National Forest Policy
[16] 1997, Martel et al. Pilot Community Deforestation Survey in the South Pacific: The Cases of Western Samoa and Niue. UNDP/SPREP

A comparison from of two SPOT satellite imagery maps by Landcare Research, one in 1994 and one six years later through the comparative analysis of land cover maps have indicated that from the period of 1994 to 2001, the area of mature forest increased from 26% to 35.5% coverage.

The above data suggests that deforestation may be a less serious concern overall. The resultant pressing issue may be the over-cropping of land already cleared for agriculture, with shorter rotation period thus affecting the fertility status of these areas.[17]

	1994		2001	
	Land area (ha)	% Area Cover	Land area (ha)	% Area Cover
Matured Forest	6805.0	26	9273.8	35.5
Secondary Forest	11232.6	43	9190.5	35.2
Littoral Forest	1313.0	5	1471.0	5.6
Littoral Shrubland	455.7	1.7	487.6	1.9
Managed land	5449.9	20.9	5329.1	20.4
Bare land	886.1	3.4	390.1	1.5
Total Land Area	26142.1		26142.1	

Table 6.1 Comparative Analysis of Land Area Coverage Between 1994 and 2001

Due to the fragmented nature of the land parcels, the access roads/bush tracks constitute a greater land area clearance than the actual plantation plot or palau itself. The plantation plot/palau may range in size from 0.5 ha to 2ha, with the average size being 1 ha.

Actual logging of the high rainforest for timber contributed only a small percentage in the forest loss between 1966 up to present day. The local timber industry had an annual harvest of 230m^3 in the late 1990s, and currently is well below that. All of which lie within the sustainable logging level of the indigenous forest of Niue, determined as being 3,500m^3. The small timber industry provides import substitution for local construction needs and is supportive of the sustainable concepts and methods of harvesting advocated.

"Deforestation in Niue is not a simple process of conversion of forest to agricultural or other land uses. But rather, forest conversion, similar to other places where shifting cultivation is practiced, is a dynamic process, with some forests being cleared, while forests regenerate in other places."

The impact of severe cyclones and potential bush fires also contribute to deforestation. A recent Government assessment report on forest damage as a result of the impact of cyclone Heta, estimated 20 percent of the trees were uprooted and some 60 percent suffered breakages and defoliation as a result of the sea spray.

[17] 2002, Tagaloa Cooper and Judy Nemaia, Niue's National Assessment Report to WSSD, Environment Unit, Department of Community Affairs.

6.3 Agricultural Practices [2, 14]

Over time there has been a cumulative effect on the land and its degradation through a number of agricultural practices, namely disc ploughing, shifting nature of agriculture combined with significantly reduced fallow periods, large scale land clearance for export cropping of taro, and the increased reliance on synthetic fertilizers/herbicides.

Historically disc ploughing was the largest single contributing factor to soil structure and fertility decline in the 1950s-1960s. The aim of the programme was to open up larger areas to extensive agriculture by removing rock outcrops and deep ripping of soils, and initially was a success. However over a period of time repeated cultivation decreased organic matter in the soil, which in turn reduced the water holding capacity, nutrient content of the soil and thus soil structure. Prior to the 1960's the main land clearance methods were slash and burn techniques and there was concern regarding the overuse of these techniques as it drastically reduced the vegetative litter, and further depleted the already critical potassium reserve of the soil.[18] Fallow periods of 12 years were needed for soil replenishment.

Introduction of bulldozers in the 1960s saw a shift in agricultural practice from slash and burn techniques to that of mechanized clearing, whilst maintaining a litter and herb ground cover to assist potassium recycling. To date 80% of all households use a bulldozer to clear land. Mechanized clearing saw a reduction in fallow period of 5 – 8 years.

And more recently, the reduction in real incomes, ability to "cheaply" clear greater areas of bush (via government subsidies), desire to increase taro production for export market (incentive to reduce unemployment - Moui Faka Niue Scheme), reliance on herbicides/fertilizers to maintain production levels has seen a further reduction in fallow period from 5 – 8 years to that of 3 – 5 years. Thus increasing the pressure on the already fragile soils, leading to further soil depletion and increased reliance on synthetic fertilizers/herbicides.

The inception of the Moui Faka Niue (MFN) Scheme has been criticized for exacerbating land clearance for agricultural purposes. The MFN Scheme sought to reduce unemployment and increase the value of exports. Assistance was channeled through different sectors of Niuean producers and included cottage industries, commercial agriculture sector and village agriculture.

Overall the scheme was effective in increasing taro exports to New Zealand through the village agriculture assistance, with growers receiving assistance in forms of, subsidized bulldozer clearing of land parcels, coordination of taro export logistics and loans for seeds, pesticides, fertilizers and equipment.[15]

[18] 1965 Wright, A C S and van Westerndorp, F J. Soil and Agriculture of Niue Island. NZ Soil Bureau Bullentin

7.0 STATE OF DROUGHT IN NIUE AND ITS RESPONSE ACTIVITIES

Accordingly, the UNCCD article 1C describes drought as "*the naturally occurring phenomena that exists when precipitation has been significantly below normal record levels, causing serious hydrological imbalances that adversely affect land resource production systems.*"

Niue experiences annual periods of necessary water conservation and/or drought. Due to the shallow and porous nature of the soils and therefore its poor water holding capacity, severe droughts have been recorded with 3 to 4 months of no rainfall.[2]

Niue is vulnerable to the effects of the El Nino Southern Oscillation (ENSO), with the warm events falling in the years of below average rainfall. According to meteorological data the worst drought from 1950 to 2003 was in 1983 and was attributed to the El Nino phenomenon of 1982/83. The impact of the drought was severe, with people drawing fresh water out of caves and the nation had to import taro (staple diet) from Samoa. The effects of the subsequent drought of 1997/1998 was not as severe as all households had reticulated water, drawn from the water lens, as opposed to the earlier system where rainwater was harvested in large catchment tanks, one per village.

Preliminary analysis of a model using observed sea surface temperature in Nino 3.4 region as a predictor for Niue's rainfall was found to be superior to using climatology. The model had the potential to predict rainfall forecast three months in advance, and could be an excellent tool in terms of "drought preparedness." [19]

According to the Department of Public Works (PWD) and Department of Agriculture, Fisheries and Forestry (DAFF) "drought" is deemed to be the period when farmers start commenting to the agencies that they are experiencing difficulty in obtaining water for their crops. The majority of farming within Niue is accomplished by hand watering. There are very few if any, areas with drip or piped irrigation. [20]

Although the authorities are sympathetic to the agricultural need for water, the priority is to ensure that there remains sufficient potable water, as the demand for water is continually high by the residents and public/government sectors. Potable water is generated from boreholes accessing the islands water lens, which is located at an average depth of 50m. There are 20 of boreholes situated throughout the island, of which 17 are currently in operation.

Water resource management is performed by observation rather than by employing predictive models and active measurements. Pumps operate continuously between 0.7 – 1 liters per second filling up tank reservoirs and are considered sustainable.

An AusAID funded Water Supply Project aimed at minimalising water wastage was successful in reducing water wastage on the island by 50%. This was achieved by increasing the efficiency of supply through improving piping and pumping systems, addressing leakages and increasing maintenance. The majority of leaks were found to be in or around household dwellings.

Management of the water resources with any precision is difficult due to the absence of information characterizing island hydrology including rainfall, land cover, consumption (demand),

[19] 2000, Rossylynn A Pulehetoa, The Relationship of Global Climate Factors Contributing to the Rainfall in Niue and Seasonal Rainfall Forecast Modeling. Niue Meteorological Service, Hanan Airport, Niue
[20] Disaster Preparedness and Mitigation Assessment (DPMA), Niue, Prepared by DPMA Team, HQUSARPAC, Honolulu, HI, USA.

water lens recharge, village bore (well) draw down, contamination levels and effects of saltwater intrusion on village bores.

According to the Disaster Preparedness and Mitigation Assessment report, Niue is unable to manage its water resources with precision due to the absence of a hydrology/groundwater model, although there is capacity on the island to maintain such a model, there does not exist the staff or personnel to create such a model.

A hydrology/groundwater model would also be beneficial in determining the availability of water for potential future irrigation projects, which would create an enabling environment for the establishment of a permanent agriculture system. Furthermore such a model could assist in the prediction of the amount of available water for irrigation versus potable.

Additionally, alternative sources of irrigation and potable water should be explored (e.g., treated waste-water recycled for irrigation). DAFF anticipates that Niueans will resist use of wastewater for irrigation, regardless of the level of treatment. For this initiative to be successful, adequate water and waste-water testing combined with public education program would be needed. A primary school educational program could incorporate discovery learning to educate the children and their parents, as has been successful in the past with Climate Change, Persistent Organic Pollutants and Water Conservation.

Water, both for potable use and irrigation, is at significant potential risk in Niue as the water lens is highly susceptible to contamination from chemical discharges, agricultural fertilizers, pesticides and sewage, especially in areas near the edge of the island and during drought conditions. Most of this eventually is directly discharged into the ocean. During normal climatic conditions, the water table constantly flushes itself by draining into the sea. However, during periods of drought, that flushing does not occur and concentration of all contaminants can occur.

8.0 OVERVIEW OF ACTIONS TAKEN TO ADDRESS LAND DEGRADATION

As previously addressed in Niue's National Report on the Implementation of the United Nations Convention to Combat Desertification, two plans/strategies had been developed, to address land degradation, although with limited success. The inception of these projects was prior to Niue becoming a signatory to the UNCCD.

- **Forestry Plantation Project**: An NZODA supported initiative with the aim of replenishing depleted soil areas through agroforestry development. The project was later scaled back in 1998 to an advisory programme for various reasons, including: poor inception, exotic forest species failed to flourish due to poor soils, monopoly leases and land tenure conflict. As a result of these factors there has been a shift in focus towards sustainable indigenous forest management and agro-forestry and is in line with that of the National Forest Policy.

- **Development of a Basic Land Capability Model**: this was an output of the LMRUP project sponsored by AusAid. The land capability model 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 most suitable crops for that particular area. Thus enabling a "suitability criteria" for land use. However there is room for improvement in the management and dissemination of this data.[3]

In addition to the above two strategies the projects listed below are currently in the process of implementation and pave the way forward to addressing some of the land degradation issues in Niue.

- **FAO Technical Cooperation Irrigation Project:** titled "Developing an Appropriate Irrigation Scheduling Strategy for the Intensification of Import Substitution Agriculture". The project is currently being implemented and was formulated in response to the Government of Niue which identified the need to increase the farmers capacity to produce import substitution crops in addition to quality export crops such as fruits, vegetables and vanilla in an effort to enhance Niue's economic sustainability.
  The major objective of the project is to assist the Government of Niue in devising, implementing and promoting a viable and sustainable irrigation plan for the intensification of import substitution agriculture. The irrigation project will further create an enabling environment for a permanent sustainable agricultural system.

- **SPC DSAP Project:** The Development of Sustainable Agriculture in the Pacific (DSAP) project is funded by the European Union and implemented by the Secretariat of the Pacific Community and is a 4-year regional project as from 2004. The main objectives of the project are to support the development of national capacities in agriculture extension, the promotion of sustainable agriculture development, improved food security and livelihoods of target farm families.
  The above objectives will be achieved through the use a participatory approach to identify farmer problems and develop strategies to solve these problems through on-farm demonstrations, training and other extension methods. The extension communications will also be enhanced through the provision of equipment, short training and technical advice.[21]

[21] 2001, "Development of Sustainable Agriculture in the Pacific (DSAP)" Project Implementation Workshop, Nadi, Fiji, 24 –26 June 2001

- **Least Developed Countries (LDC) and Small Island Developing States (SIDS) Targeted Portfolio Approach for Capacity Development and Mainstreaming of Sustainable Land Management (SLM):** Developed by UNDP – GEF in response to the need for greater project effectiveness and impact, while at the same time reducing administrative costs/burdens. Approved in September 2004, the Portfolio Approach only focuses on those countries that have not completed their NAPs and otherwise show weakness in capacity for SLM, as they constitute a special group of countries with similar needs and constraints.
  The Project is available to assist 49 LDC and SIDS countries that have not yet completed their National Action Programmes (NAP) to Combat Desertification, in order to develop individual, institutional and systemic capacity for sustainable land management, of which Niue is eligible. In essence the Portfolio Approach is a cost effective way of delivering a large number of relatively small projects to these countries in a timely manner. Through this Niue is able to access an expedited medium-sized project (MSP) under the Portfolio Approach.

- **National Capacity Needs Self Assessment (NCSA):** The objective of this project to carry out an assessment of Niue's capacity to address and implement global environmental issues, in particular those relating to Niue's obligations under the Convention on Biological Diversity (CBD), the Framework Convention on Climate Change (UNFCCC), and the Convention to Combat Desertification (UNCCD). This objective will be achieved through a series of internal self-assessments to be carried out by the government agencies and organsations (the stakeholders) who have direct responsibilities for environment management and development matters in Niue. The ultimate aim of the NCSA is to catalyse domestic and externally assisted action to meet Niue's needs and priorities for capacity building in a well-planned and coordinated manner.

It is important to note that the existing sister conventions, namely Climate Change and Convention of Biological Diversity have also incorporated into their action/mitigation plans land degradation issues. It is therefore pertinent to increase harmonization between these conventions and resultant projects through the strengthening of interdepartmental linkages so as to avoid duplication. This is of particular relevance to the Public Works Department, which coordinates land clearance and houses the Water Supply Division, Department of Environment, Department of Agriculture, Forestry and Fisheries and Department of Justice, Lands and Survey.

8.1 Existing Policies and Legal Frameworks That Account for Land Degradation and Sustainable Land Use. [2, 16]

8.1.1 Legislation

Environment Act 2003: The objectives of the Act are to, provide a mechanism for the development of environmental policy and law, establish an Environment Department, and provide enforcement powers for environment officers.
The Act takes into consideration the following;

- The maintenance and enhancement of the quality of the environment;
- The efficient use and development of natural and physical resources;
- The concept of sustainable development;
- The protection of the water lens from contamination;
- The protection of indigenous flora and indigenous fauna and their habitats;
- The protection of the coastal zone from inappropriate use and development;
- The protection of historic areas from inappropriate use and development;
- The relationship of Niueans and their culture and traditions to their lands and historic areas;
- The conservation and sustainable use of biological resources;
- The compliance to multilateral environment agreements Niue is a party to.

The Environment Act in itself is a general multipurpose act designed to be constantly reviewed and updated by additional regulations where deemed appropriate by Government.

Water Resources Act 1996 (includes the responsibility of Village Councils): Aims to ensure the optimum development and use of Niue's water resources; the coordination of all activities which may influence the quality, quantity, distribution, use and management of water; the application of appropriate standards and techniques for investigation, use, control, protection, management and administration of water resources; and the proper disposal of any water products that could pollute water.
There are currently no regulations in place to enforce the Water Resources Act, and are unlikely to be instigated in the near future due to the financial constraints associated with the enforcement of the regulations.

Mining Act 1997: Provides Cabinet with the authority to grant and regulate the granting of prospecting licenses. It includes a provision determining that the area of land in a mining lease shall not exceed 40 acres and the length of the area, as far as practical, shall not exceed twice its width.

Land Ordinance 1969: includes a provision to allow the court, on application of any *leveki magafaoa* and with the consent and the majority of the members, to set aside any Niuean land for a reserve, fishing ground, village site, land place, place of historical interest, water supply, church site, building site, recreation ground, bathing place or any other specified purpose.

Village Council Ordinance 1967: Includes identification of the function of Village Councils to undertake, provision, construct and maintain, manage and regulate in the following sustainable land management areas –

- Bush roads (except public roads)
- Public parks, gardens, recreation areas, scenic resorts and lookouts and other public places, reserves and land vested in the Council or placed under the control either permanent or temporary
- Establishment and maintenance of forest plantation and natural forest reserves
- Agricultural, horticultural and forestry industries and the economic use of Niuean Customary land
- Protection of fish resources, flora and fauna.

8.1.2 Policies

Niue National Forest Policy:
Endorsed by Government in December 2000 and receives funding and technical support from SPC and GTZ. The overall aim is for the conservation and sustainable use of the remaining forest areas on Niue. The objectives listed below outlined in Niue's Forest Policy also address land degradation and sustainable land use and include:

- Promoting the sustainable use of Niue's indigenous forest and assisting communities to manage these as a renewable resource;
- Supporting customary conservation practices and community-based conservation areas;
- Promoting integrated land use practices to reduce the need to clear more forest;
- Developing a sustainable local timber industry; and
- Promoting plantation forestry within communities with emphasis on indigenous species and agro-forestry.

8.1.2.1 Departmental Cooperate Plan/Policies

Department of Agriculture, Forestry and Fisheries: focus is to promote and protect the development of agriculture, fisheries and forestry in a sustainable manner and include:

- Improve and promote sustainable agriculture farming systems
- Promote and practice biological control and the use of integrated pest management
- Promote the sustainable use of forest resources and encourage the establishment of forest plantations

Department of Environment: Recently established as a department on its own under the mandate of the Environment Act. The department's focus is to administer and implement the Environment Act and has the following functions that relate to land degradation:

- To formulate environmental and resource management objectives;
- To facilitate in the formulation on environmental policies and legislation;
- To design and implement programmes with line agencies for, environmental planning and natural resources management; environmental impact assessment; waste management and pollution control; nature conservation; protection of historic areas.
- To promote environmental awareness, public information campaigns, and environmental education;
- To review environmental legislation, including this Act, and where necessary to propose amendments and regulations;
- To monitor, and enforce environmental laws and policies;
- To promote community involvement in environmental decision making;
- To encourage and foster knowledge, innovations and practices embodying traditional lifestyles that promote the protection, conservation, improvement and management of the environment;
- To facilitate compliance to and implementation of multilateral environment agreements relating to the environment.

Department of Public Works: The water supply division is a key division with a sustainable focus on water supply and is largely guided by the Water Resource Act. Its Corporate Plans include the promotion of water conservation and ensuring the sustainable use of water resources among the objectives.
The Civil Construction Division manages the bulldozers for land clearance and identifies that it works closely with the Moui Faka Niue (MFN) scheme and the Growers Association, but it does not record any environmental objectives.

Department of Justice, Lands and Survey: Indicative of the title, the department is responsible for surveying and titling of untitled land, in addition to environmental planning which includes the effective management of land and resources. The corporate plan incorporates the following key objectives in relation to the sustainable development of resources.

- Provide the Government of Niue with the institutional capacity for the planning and management of all uses of natural and cultural resources.
- Formulate land and resource use policies, strategies and guidelines for co-ordinating sustainable development.
- Ensure integrated decisions relating to planning and land management, resource use and conservation.
- Provide reliable land and environment related information.

Niue Tourism Office: Reestablished under the Niue Tourist Authority Act 1995, the Niue Tourism Office ensures that the promotion and marketing of Niue does not conflict with the national goals and strategic plans of the country. Recognition of the importance of the environment to tourism led to the drafting of an Accreditation Scheme for the tourism industry, incorporating Environment Management Guidelines to be followed by those participating in the Scheme. The Accreditation Scheme is a prerequisite for potential Tourism Operators wishing to apply for a loan with the Niue Development Bank.

Two objectives in the Niue Tourism Charter specifically relate to environmental responsibility and are:

- Adopt environmental friendly-type practice minimizing exploitation of natural resources and thus reducing adverse effects on the environment.
- Maintain and enhance the natural beauty of Niue.

National Council for Sustainable Development (NCSD): Yet to be established under the Environment Act 2003 and to comprise of representatives from government departments, private sector, community interest groups and the Director for Environment. The aim of the NCSD is to replace the various existing steering committes with one overall "watchdog" and in turn the steering committees become working groups. The functions of the NCSD include the following:[22]

- To review and provide feedback on environmental policy to ensure it can be realistically implemented across all government and non-government organizations and the community.
- To raise the profile of environmental issues and commitment to environmental issues through representation to Cabinet and to *specific government agencies.*
- To co-ordinate the implementation of environmental policy across all relevant government and non-government departments and the community.

[22] 2003 National Report on Interlinkages in Niue – Powerpoint Presentation, Tagaloa Cooper, Department of Environment, NIUE

- To promote the implementation of environmental policy with an understanding of links to other sectoral policies within their own organisation or community.
- To facilitate interagency sharing of information relevant to the environment.
- To assist in the co-ordination of community awareness, education and community consultation activities
- To provide support and advice regarding specific projects on the implementation of that project.
- To monitor the performance of specific projects through evaluation of three monthly reports produced by the project co-ordinator and project team.
- To provide quality control of technical and policy reports on specific projects prepared by the national consultants and project co-ordinators.

9.0 NATIONAL ACTION PLAN

9.1 Methodology

Niue has been extensively consulted through participatory stakeholder consultations on a large number of environmental issues with recommendations recorded in reports such as, NEMS, SOE, NBSAP, Initial National Communication for UNFCCC, Niue National Forestry Policy, Niue's National Report on the Implementation of the UNCCD, and the WSSD Niue National Report.

The National Action Plan has been formulated as a result of the following:

- Literature review of previous environmental recommendations which relate to sustainable land management and address the issue of land degradation
- Consultation with key departmental personnel. *Refer to Appendix v*.
- Participatory workshops in order to further formulate a National Action Plan with
- stakeholders. *Refer to Appendix vi.*
- Circulation of the draft National Action Plan to key stakeholders present at the workshop for final validation.

The key thematic areas identified which address land degradation in Niue were sustainable management of land clearance, soil diagnostics, soil rehabilitation, sustainable cropping management practices, agroforestry, forestry, waste water and water resource management, capacity building and governance. Care was taken to address all issues pertaining to land degradation while at the same time ensuring that these objectives were realistic, practical and achievable.

9.2 Sustainable Management of Land Clearance[2,3]

"Continued land clearance of regenerating secondary and primary forest will lead to pressures on the islands biodiversity."[2] This is exemplified by the fact that 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).[1] If land clearance was constrained to the clearing of scrub/fallow areas in conjunction with sustainable crop management practices, then ideally there should be no need to further clear primary forested areas.

Actions that address this include:

Development of a Code of Practice for land clearance using best practice which include the following;

9.2.1 Training bulldozer operators to ensure a reasonable layer of vegetative litter remains, and minimize disturbance to the soil.

- ✓ Build up of organic matter within the soil, aids enhanced soil structure, water capacity holding characteristics, nutrients, beneficial microbes and improves water quality.

9.2.2 Provision of incentives to clear/use fallow/scrub areas as opposed to the clearance of regenerating/primary forested areas.

- ✓ Encourage regeneration of forest areas
- ✓ Sustainable cropping management practices endorsed
- ✓ Improved fallow management

9.2.3 Utilisation of the D6 bulldozer that is incapable of clearing large trees/bush cover associated with regeneration of forest areas.

- ✓ Encourage regeneration of forest areas

- ✓ Sustainable cropping management practices endorsed
- ✓ Improved fallow management

9.2.4 Replanting of native forestry trees in secondary regenerating areas: agroforestry

9.2.5 Planning of land clearance through the use of land capability and soil suitability maps.

- ✓ Minimize deforestation
- ✓ Maximize soil potential without degradation
- ✓ Minimize land degradation

9.3 Soil Diagnosis

Productive soil builds the foundation for any successful agricultural operation. Therefore assessing, maintaining and improving soil quality are essential considerations when selecting crop types, inputs and management options.[23]

9.3.1 Updated diagnostic analysis of different soil types on Niue and implement management practices accordingly. First priority would be soils currently under cultivation in order to avoid further degradation, eg. Areas of large scale production such as the Vaiea nonu farm and various other large scale plantations, market garden areas, and taro plantations. Second priority would be the degraded soils/land for rehabilitation options.

Soil diagnostics would include: soil biological characteristics such as fungal content – beneficial microbes/mycorhizae, physical characteristics such as soil depth and chemical characteristics such as pH and limiting micronutrients.
Care must be exercised to compliment existing data and thus avoid duplication.

- ✓ Informed management of soils according to state, type and depth.

9.3.2 Nutrient balance study. In depth analysis of nutrient requirements for sustainable cropping for all major crops grown for local consumption and export market.

- ✓ Efficient crop nutrient management
- ✓ Assist soils with accurate fertilizer applications specific to the crop.
- ✓ Reduced leaching of applied nutrients
- ✓ Overall reduction of environmental impact.

9.4 Soil Rehabilitation

Soil structure enhancing land use systems are those that optimize, and generally increase the soil organic matter content, the activity and species diversity of macro- and meso-fauna. Such systems include mulch farming, conservation tillage, frequent use of planted fallows and cover crops, appropriate rotations and crop sequences and combinations.[24]

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[23] August 2004, Participant's Workbook for a Training in Crop Production, Notes Compiled for the Young Farmers of Niue. DSAP, SPC

[24] 1994, R. Lal. Sustainable Land Use Systems and Soil Resilience pp 41 – 67, © 1994 CAB INTERNATIONAL Soil Resilience and Sustainable Land Use Eds. D J Greenland and I Szabolcs

9.4.1 Large scale mulching/composting.
Potential utilization of grass clippings from village greens and the airport area

- ✓ Improvement of soil structure, fertility, water holding capacity, microbes and water quality

9.4.2 Comparative performance analysis of various green manure crops
Eg. Mucuna legume crop: reportedly fast growing, high biomass production, makes available withheld P to plants, particularly relevant to ash soils. Successful in PNG, Fiji and Tonga[25]

- ✓ Increase in biomass, nitrogen fixation, leading to improved soil fertility and structure

9.4.2 Improved fallow management, planted fallows as opposed to natural fallows

- ✓ Reduced resting periods
- ✓ Increased sustainable intensive agriculture practices
- ✓ Rehabilitation/maintenance of soil characteristics

9.4.3 Improved resting crops through the identification of superior performing legumous crops suitable for Niuean soils/conditions
Eg. Casava reported in Asia to increase soil fertility significantly over a 3 year period where P is a limiting factor. Method is also practiced in Hapai, Tonga.[22]

- ✓ Increased fertility due to large biomass volume
- ✓ Reduced fallow period
- ✓ Reduced encroachment of forested areas

9.4.4 Improved crop rotation systems

9.4.5 Investigate options for the rehabilitation of previous areas of mineral extraction (*makatea* pits)

9.5 Sustainable Cropping Management Practices

No agricultural system will be sustainable if it is not economically viable both for the farmer and the society of which he/she is a part. But economic sustainability cannot be bought at the cost of environmental or physical damage that leads to irreversible soil degradation or uncontrollable outbreaks of pest, diseases and weeds.[24]

9.5.1 Improvement of Organic Content/Microbial Activity of Soils through

- Large scale composting/mulching project
- Comparative analysis of various green manure crops
- Investigation of the presence of beneficial mycorhizae in the soil; if absent then the potential for its introduction

[25] Dr Siosiua Halavatau, Soil Scientist, Technical Support, Development of Sustainable Agricultural Practices, Secretariat of the Pacific Community (SPC), pers. comm.

- Development of "compost tea" techniques and its application.
  Beneficial in terms of addition of organic nutrients plus increases plants ability to resist diseases eg. powdery mildew on cucumbers,[26] grey mould on tomatoes and peppers[27], Fusarium wilt on tomatoes[28]

- Encouragement of conservation tillage

9.5.2 Active encouragement of organic farming practices including the incorporation of traditional knowledge from within Niue and the region.

9.5.3 Encouragement of intercropping.
Eg. Nonu/mucuna, vanilla/nonu, vanilla/gleracidia, coffee/coconut palms, fruit trees/mucuna, gleracidia/coffee

- ✓ Green manure is mucuna, gleracidia, resulting in increased biomass and an overall soil rehabilitation effect.
- ✓ Simultaneously with soil rehabilitation, is the production of a viable economic crop

9.5.4 Assist with the development and marketing of indigenous economically viable and agriculturally sustainable crops eg nonu, vanilla.

9.5.5 Feasibility study investigating the use of bio-fertilizers (non GMOs) as opposed to synthetic fertilizers
Eg Azotobacter, which is a free-living nitrogen-fixing bacterium and is used as a biofertilizer in the cultivation of most crops. The application of the Azotobacter biofertilizer at the rate of 20 kg per hectare per year assures a substantial saving of nitrogen fertilizer (about 50 % reduction in N requirement). Soil health is also improved by increased microbial activity.[29]

9.6 Agroforestry

Agroforestry is viewed as a viable option to rehabilitate depleted soils whilst at the same time offer a form of economic returns, both short term and long term pending on the species combination chosen and management practices.

9.6.1 Investigation of alternative economically viable and sustainable agroforestry options eg nut and fruit trees, vanilla: Desk study of successful agroforestry systems in other Pacific Island countries, and the potential of its application to Niuean conditions.

9.6.2 Conduct research trials on varying agroforestry practices/species combinations and soil suitability throughout the island

[26] Weltzein, Heinrich C. 1989. Some effects of composted organic materials on plant health. Agriculture, Ecosystems and Environment. Vol. 27. p. 439-446
[27] Elad, Y., and D. Shtienberg. 1994. Effect of compost water extracts on grey mould (Botrytis cinerea). Crop Protection. Vol.13, No. 2. p. 109-114.
[28]
[29] www.nrdcindia.com/pages/azotobacter

9.7 Forestry [9]

"Sustainable forestry for Niue is defined as the wise use of Niue's rainforests for long-term economic and ecological benefits and where harvesting and forest conversion does not diminish the benefits to future generations: this requires protections of soil, water, wildlife and timber resources in perpetuity."

According to Niue's National Forestry Policy there is an estimated 15,000 ha of unused/degraded land with a potential for merchantable forest. However potential forestry programmes within Niue need to be based on proven and tested research results which take into consideration Niue's unique biophysical characteristics.

9.7.1 Rehabilitation of soil through the use of high performing indigenous green cover crops under trees eg *micans, gliricidia, sitratro.*

9.7.2 Forestry schemes to be directed towards replanting areas as opposed to harvesting, as very little deforestation is due to forestry activities.

9.7.3 Utilization of indigenous tree species as opposed to that of the poor performance of exotic species. And would include the mass propagation of indigenous species for re-forestation

Incorporate tree species that are beneficial to the fruit bat and pigeon.

9.7.4 Research investigating appropriate tree species to the soil conditions of proposed planting sites.

9.7.5 Investigation of the presence of beneficial mycorhizae and their possible introduction for enhanced tree growth.

9.8 Waste Water and Water Resource Management

Niue has no running water but relies on water reticulation through its fresh water lens. It has been estimated that only 30% of the total rainfall recharges the water lens. Water availability for sustainable agricultural and cropping was ranked as a high priority in recent preliminary consultations for the Development of Sustainable Agriculture in the Pacific (DSAP)[30]. Currently a FAO Technical Cooperation Programme for irrigation is being initiated for large scale commercial growers/market gardeners. However without a suitable hydrology model, Niue is unable to effectively manage its water resources nor mitigate against the effects of drought.

9.8.1 Development of a ground water/hydrology model for Niue. This is critical in order to determine the availability of water for potable use versus irrigation and as a drought mitigation tool.

9.8.2 Investigation of alternative water supply sources, such as rainwater harvesting and desalinization of seawater, as a safe alternative to groundwater in preparation for times of drought, power failure and possibly the potential contamination of the water lens.

[30] 2004, Development of Sustainable Agriculture in the Pacific (DSAP). Preliminary Consultations – NIUE, June 2004

9.8.3 Feasibility study on the potential of utilizing effluent disposal as a nutrient source for forestry or agriculture and improving soil fertility and structure[31]. Ideally more suitable for forestry/fruit trees as opposed to vegetables. *Refer Appendix viii.*

9.8.4 Encourage household recycling of grey water for ornamental plants, trees and vegetables.

9.8.5 Development of a small treatment facility to treat waste-water which can be recycled for irrigation, and prevents contamination of the water lens

9.9 Education and Awareness [2,15]

Effective education and awareness programmes aimed at the community level is the fundamental prerequisite for change. An advantage of Niue's small population is that education and awareness programmes are far reaching at all levels of the community. The disadvantage being, that given the number of environmental programmes currently being implemented, each environmental education and awareness campaign are competing for the same audience. A coordinated environmental education and awareness approach implemented by the Department of Environment would go some way towards addressing this, in addition to the benefits of cost sharing.

9.9.1 Publication of resources in books, leaflets, fliers, and videos. Production of materials that would be applicable for the schools to incorporate into their curriculum.
Eg Niue Primary School already participating in an organic gardening programme, a component on soil rehabilitation could easily be included.

9.9.2 Development of new and innovative methods of sharing and disseminating information coordinated by the Department of Environment.

9.9.3 Develop active national and village environmental education campaign on sustainable agriculture, forestry and land rehabilitation. Include successful examples from other countries within the region.

9.10 Capacity Building Requirements[31]

The recent approval of the project titled National Capacity Self Assessment (NCSA) will assist in further identifying the capacity gaps for the implementation of the proposed Action Plan to address land degradation in Niue. This will be implemented as an overview of the capacity constraints relating to Niue's fulfillment of its obligation to environmental conventions. However although the project identifies "the gaps", it does not attempt to "fill the gaps".

As with other Small Island Developing States, Niue's largest constraint in fulfilling its international obligations are that of finances and capacity. Lessons learnt from previous capacity building initiatives have identified that training and human resource development alone is of no benefit, without the necessary tools/hardware/equipment thus creating an enabling environment.

[31] 1998, Coral Pasisi, Capacity Building for Environmental Management in the Pacific. Country Report for Niue.

9.10.1 Training and Human Resource Development

- Training of bulldozer operators:

a. To ensure an effective vegetative litter layer remains with minimal disturbance to soil layer

b. To identify areas most at risk to land degradation, through land capability and soil suitability maps and advise landowner accordingly.

- Training agriculture extension officers:

a. In depth training in the effective use/application of land capability and soil suitability maps. Develop a generalized working knowledge of different soil types, capabilities and area they exist.

b. Soil testing techniques, its interpretation of soil data and the ability to formulate recommendations from the data.

c. All aspects of integrated sustainable cropping management practices including agro forestry and soil rehabilitation through the participation at regional workshops/formal training at recognized regional institutions and forming close collaborative links with specialized regional organizations.

d. Ability to investigate alternative agricultural practices including traditional methods/knowledge through consultation, literature reviews and applied research

- Training of Forestry Officers:

a. In depth training in the effective use/application of land capability and soil suitability maps. Develop a generalized working knowledge of different soil types, capabilities and area they exist.

b. Soil testing techniques, its interpretation of soil data and the ability to formulate recommendations from the data.

c. All aspects of agroforestry options and forestry practices including soil rehabilitation through participation at regional workshops/formal training at recognized regional institutions and forming close collaborative links with specialized regional organizations.

d. Ability to investigate alternative forestry/agroforestry practices including traditional methods/knowledge through consultation, literature reviews and applied research.

- Training of Environmental Officers

a. In depth training in the effective use/application of land capability and soil suitability maps.

b. Ability to integrate the above information into the Environmental Impact Assessment Report (EIA).

c. Increase the capacity to conduct and vet EIAs.

d. Utilisation of the Integrated Environment and Landuse Planning Guidelines as a working tool for Department of Environment.

- Training of Water Division Personnel

a. Training of personnel in water quality management and includes, water quality assessment methods, physical, chemical and biological data collection and analysis techniques, resource condition assessment and reporting

- Training of Land Users/Farmers

a. In the access to and use of available resources relating to land capability and soil suitability criteria.

b. Through the effective participation of land users/farmers at all stages of research, development and testing of improved technology/practices

9.10.2 Specific Sector Requirements

- Department of Agriculture, Forestry and Fisheries:

a. Increase the department's capability to carry out large scale composting/mulching activities through the availability of the necessary equipment/facilities/tools required.
b. Increase the department's capacity via the necessary facilities/equipment to undertake soil analysis/research, further develop soil analysis for each large scale grower/operator (Bulk send soil samples for testing –finances to be made available)
c. Increase resource base so as to facilitate applied research trials in soil rehabilitation/sustainable cropping, agroforestry, and the investigation of the use of indigenous trees for plantation forestry.
d. Conduct research and feasibility analysis of alternative indigenous species and high value crops. Training to include techniques and information sources for monitoring markets and research developments.
e. Recruitment of a soil scientist to undertake soil analysis/research and incorporation of data into a land capability/suitability model.

- Water Supply Division: Public Works Department

a. Increase the division's capacity from a supply and infrastructure provision agency to a water resource use and management agency. This would in turn necessitate a water hydrology model for Niue, water resource protection policy, strategy plan including drought mitigation, guidelines and criteria development, and modeling systems for alternative sustainable catchment yields for water supply.

- Department of Justice, Lands and Survey

a. Ongoing capacity training to further develop and update information relating to land and resource use, and particularly the land capability/suitability model.
b. Increase the department's capability through the acquisition of a larger server-based computer database system for all information relating to land and resource use/planning, which then could be networked both internally and externally. Deemed essential in order for the department to fulfill its core objectives.

9.10.3 General

- Institutional strengthening on issues pertaining to soil rehabilitation, land degradation and rejuvenation for coral atoll agriculture systems.

- Increase the small scale attempt at sustainable agriculture into a large scale coordinated nationwide project with particular emphasis on soil fertility/rehabilitation.

- Utilisation of technical backstopping from regional agencies. For example, where key personnel are being further developed, a volunteer, such as VSA or UNV can assist until such time that the person returns from training.

- Become proactive in accessing and compiling all technical information and reports relating to land and resource use done on Niue by various regional technical agencies and private companies.

- Strengthening of interdepartmental linkages in addition to key stakeholders and NGOs.

- Governmental departments to become more familiar with accessing information relating to GPS and GIS from DJLS, which serves to consolidates all information relevant to land use.

- Capacity to utilize and maintain the DJLS Land and Planning information as a working tool for all sectors.

- Closer collaborative cooperation of regional technical agencies such as SOPAC, SPREP, and SPC in assisting PICs meeting their international obligations.

9.11 Governance

Effective governance of the Action Plan would include the following, in addition to the number of governance practices currently in place, which include; Environment Act; proposed establishment of the National Council for Sustainable Development under the mandate of the Environment Act; National Forest Policy; and the Village Council Ordinance.

- Establishment of benchmarks and indicators for effective monitoring.
- Periodic monitoring, assessment and update
- Utilisation of the Integrated Environment and Landuse Planning Guidelines as a working tool
- Development of a Land Clearing Code of Practice
- Best practices for governance taken from within the region
- Development of Access Protocols with different levels of information access pending on justification eg. Government Department vs. NGO vs. potential overseas investor.

10.0 THE WAY FORWARD

As previously specified in Niue's National Report on the Implementation of the UNCCD 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, biodiversity conservation, constitutional rights, socio-economic factors and cultural values in Niue.

Historically soil programmes have been limited to small-scale extension projects, fertilizer and fodder experiments. The national action plan consultative process identified the need to increase the small-scale attempt at sustainable agriculture into a large scale coordinated nationwide project with particular emphasis on soil fertility/rehabilitation. This is feasible given Niue's size and population and is in line with Niue's strategic plan.

Furthermore Niue could be used as a pilot initiative for the advocacy of the rehabilitation of degraded land and sustainable land use management for atoll agriculture.

Water resource management or lack of it was also clearly identified, particularly the need for a hydrology model to measure Niue's water lens in order to provide the capacity to assess the availability of water for potable use vs. irrigation, and the formulation of effective mitigation measures in times of drought. Agricultural irrigation would in turn enable a sustainable agricultural environment.

Another significant key to improving land use is the provision of information to the community. The development of a limited soil and land capability system addresses this to some extent however there is a need for better dissemination of this information to the community and in an improved/updated form which is better understood by the community and allows for rational decision making.

Although committed to sustainable development as reflected in its strategic plan, environmental acts, policies and ordinances, small island states such as Niue lack the financial, technical capacity and resources to fulfill their international obligations and addressing one without all would be redundant.

Finally and most importantly the efforts of small island states such as Niue, to overcome the difficulties in the pursuit of sustainable development deserve international cooperation in identifying financial avenues in order to implement their National Action Plan and could include, multilateral and bilateral donors, foreign direct investment, and environmental trust funds to name but a few.[32]

[32] 1994, Barbados, Programme of Action for Small Island States, UN and Earth Summit

LIST OF APPENDICES

Appendix i: Classification of Niue's Soil Types and Land Use Suitability

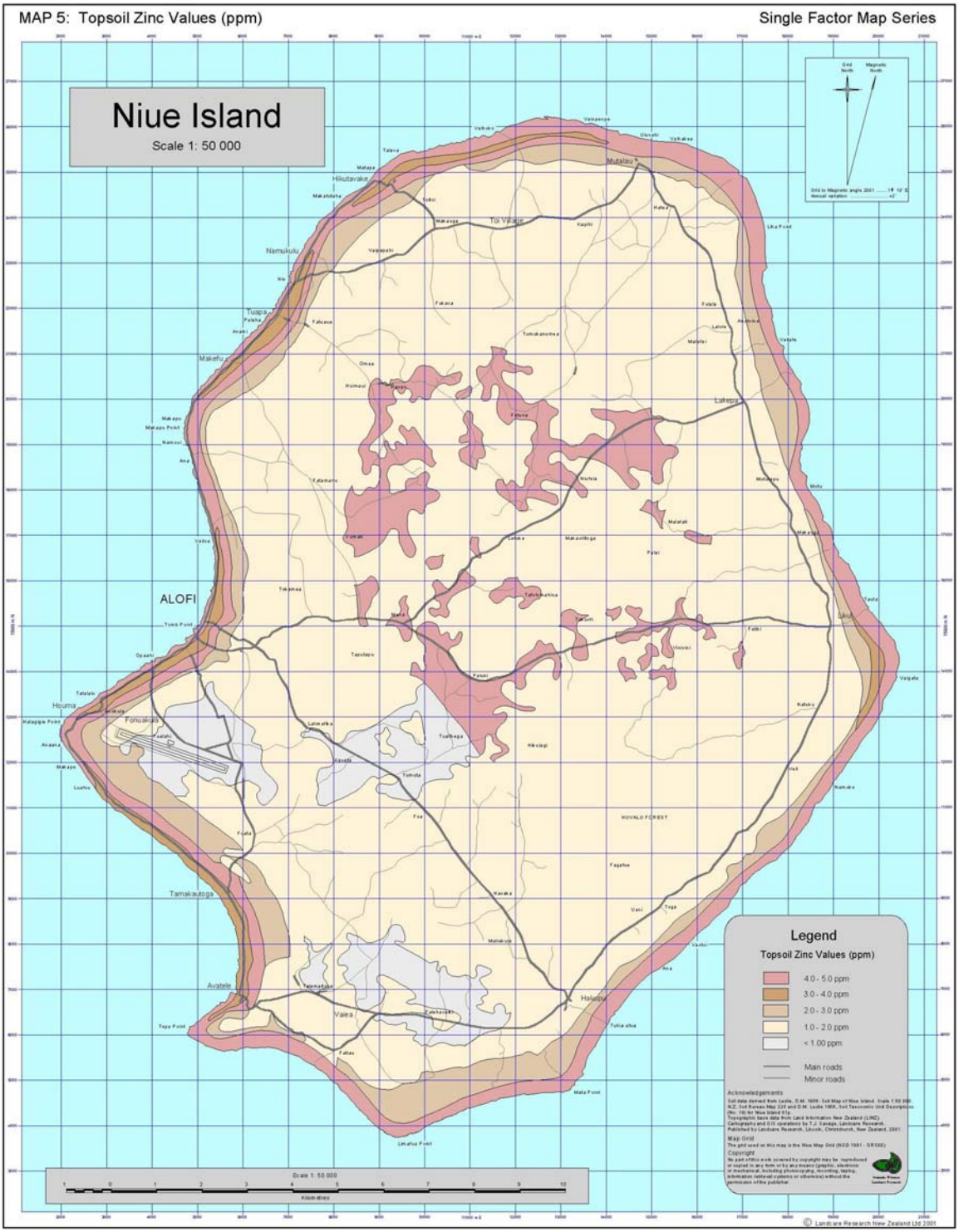
Soil Type	Geographical Distribution	Total Area (ha) of Soil Type	Vegetation and Land Use	Soil Limitations
Avatele	Confined to long and narrow units on the Alofi terrace near Liku village east coast, and along the north and west coasts of the island	453	Many of the villages are located on this soil and are utilized for the ful range of subsistence vegetables, root corps and tree crops. In the natural state supports regenerating forest species and forest ferns.	Rock outcrops (up to 10 %); seasonal soil moisture deficits; slight to moderate alkaline; and very high P retentions (high P reserve), subsoil zinc deficiency and very low potassium reserve.
Fetiki	Extensive within the karst landscape of the 'ancient lagoon' in the central part of the island.	2,808	Although distant from the villages, is used extensively for yams, kumaras and taros, and subsistence banana cropping. In the natural state supports a tall forest, dominated by ***kafika*** and ***kolivao*** and luxuriant understory of ferns with regenerating tree species.	Rock outcrops (30-40%); profile shallowness (< 60cm) and severe seasonal soil moisture deficits; high P retention (high P reserve), sinc deficiency and low potassium reserve
Foa	Forms an extensive concentric distribution on the karst landscape of the 'Mutalau reef' which encloses the central 'ancient lagoon' of the island	4,553	Used for taro, yam and kumara, but with a bush fallow interval of 5 to 7 years. Coconuts are common and do well. Former vegetation was probably forest, but few remnants of this original cover now remain. Unused land are covered by tall bushes and small trees.	Rock outcrops (up to 50%); seasonal soil moisture deficits; moderately alkaline subsoils; and very high P retention (high P reserve), subsoil zinc deficiency and very low potassium reserve
Fonukula	Although most extensive in the south-eastern sector of the island, patchy distribution pattern on the 'desert plain' landscape of the ' Mutalau reef' which encloses the central 'ancient lagoon' of the island	2,703	Mainly used for taro and kumara crops, but with a bush fallow interval of 8 to 15 years. Were widely used in the past for the common tree crops (coconut, banana, breadfruit). Only few remnants of this original forest cover now remain. In the unused state covered with fern, and open, low, second-growth forest.	Moderately rapid permeability, low water holding capcity and seasonal soil moisture deficits; slightly alkaline topsoil pH; high P retention (high P reserve), zinc deficiency and very low potassium reserve
Hakupu	Forms a narrow and continuous encircling unit within the karst landscape and the outer rim margins of the 'Mutalau reef'	1,820	Mainly used for taro and coconuts. The original cover was forest and in the more exposed locations coastal scrub, where remnants remain. Blue algae cover rock outcrops.	Rock outcrops (50%); surface stones (<20%); moderately severe moisture deficits; slightly alkaline and high P retention (high P reserve), zinc deficiency and very low potassium reserve.
Hikutavake	Forms a narrow and continuous concentric unit at the outer margins of the island, where it extends from sea level up onto the karst landscape of the 'Alofi terrace'	2,091	Forest and scub remnants are extensive. Despite excessive rockiness, is one of the more productive soils of the island. Breadfruit and mango trees grow well in the eastern coastal districts; bananas and root crops likewise thrive wherever pockets of deeper soils can be found.	Rock outcrops (50%); surface and profile stoniness; Moderately rapid permeability, low water holding capacity and moderately severe moisture deficits; moderately alkaline and very high P retention (high P reserve), zinc deficiency and low potassium reserve.
Mutalau	Most extensive to the north of the island in association with Toi series. Forms a near continuous encircling unit within the karst landscape on the elevated plateau run of the ' Mutalau reef'	2,421	Original forest in which ***kafika*** is dominant, is extensive. Coconut and most varieties of taro grow fairly well	Rock outcrops (<25%); surface stones (20-40%); slight sheet erosion risk on slopes <2%(during periods of high storm intensity); severe seasonal soil moisture deficit; slightly alkaline; very high P retention (high P reserve), zinc deficiency and very low potassium reserve.

Soil Type	Geographical Distribution	Total Area (ha) of Soil Type	Vegetation and Land Use	Soil Limitations
Niufela	Has a patchy distribution pattern that is related to the occurrence of the 'desert plain' landscape (fernlands) of the central 'ancient lagoon'	1,436	The soil grows very good coconuts and yams, and fairly good crops of bananas and kumaras. Some areas support the original forest cover in which ***kafika*** is dominant. Elsewhere, fern species and secondary scrub are predominant.	Rock outcrops (<20%); subsoil stones and boulders; slight wind erosion potential; profile shallowness, low water holding capacity and severe seasonal soil moisture deficit; slight alkalinity; very high P retention (high P reserve), zinc deficiency and low potassium reserve
Palai	Extensive throughout the central depressed plateau of the island, where its distribution pattern is related to the occurrence of the karst landscape, across this 'ancient lagoon' surface	3,379	Previously one of the main commercial banana growing soils. Taro also grows well. While many areas of the soil support secondary scrub and regenerating forest species, most of the area is under the original forest cover (the tapu area of the Huvalu forest is mainly Palai series) in which ***kafika*** dominates with ***kolivao***.	Rock outcrops (40-60%); moderately rapid permeability, low water holding capacity and seasonal soil moisture deficits; soil alkalinity; and very high P retention (high P reserves), zinc deficiency and very low potassium reserve
Toi/Mutalau	See Toi and Mutalau soils	1,409	See Toi and Mutalau soils	See Toi and Mutalau soils
Tafalomahina	Similar to Niufela series – it has a patchy distribution pattern related to the occurrence of the 'desert plain' landscape (fernlands) of the central 'ancient lagoon'. More extensive at the northern margin of this central depressed plateau	260	Historically heavily cropped and is commonly found near the sites of the ancient inland villages. The soil was reputed to have grown good taro crops. An excellent soil for kumaras and yams. Where unused supports fern species and scrub species. A feature of bared soil surfaces are algal crusts of gelatinous *Nostoc* colonies (which fix atmospheric nitrogen)	Moderately rapid permeability, profile shallowness, low water holding capacity and severe seasonal soil moisture deficit; slight wind erosion potential; minor prodile stoniness; soil alkalinity; high P retention (high P reserve), zinc deficiency and low potassium reserve.
Toi	Forms long narrow units within ' the desert plain' landscape (fernlands) on the elevated plateau rim margins of the 'Mutalau reef' at the south and east of the island. Most extensive to the north of the island in association with Mutalau series	1, 445	Is almost always extensively planted in coconuts which grow very well. Grows moderately good taro and banana crops. Remnants of the forest that originally grew on these soils can be seen now at only at Huvalu forest.	Surface stones (20%); moderately rapid to rapid permeability, low water holding capacity; profile shallowness and severe seasonal soil moisture deficits; slightly alkaline; high P retention (high P reserve), zinc deficiency and low potassium reserve.
Tumufa	Occurs as four broad areas in the south-eastern sector of the island where its distribution pattern is related to the occurrence of the 'desert plain' landscape (fernlands) of the elevated plateau rim and rim margins of the 'Mutalau reef.'	994	These soils are only of limited value for agriculture in their natural state. Cassava is the only crop that consistently produces a fair yield on these soils. For may years this soil has been burned annually to facilitate the collecting of wild arrowroot tubers. Commonly support fern and scrub and in areas of bared ground gelatinous *Nostoc* colonies predominate.	Slight profile stoniness (10-15%); past erosion (combined with fertility degradation) with moderate erosion risk; rapid permeability, very shallow profile depth, sever seasonal soil moisture deficits; slightly alkaline; very high P retention (high P reserve), zinc deficiency and very low potassium reserves.
Vaiea	The series is not extensive and occurs in four areas in the southern part of the island where its distribution pattern is related to the occurrence of the 'desert plain' landscape (fernlands) of the elevated plateau rim and rim margins of the 'Mutalau reef'.	402	The present vegetation in nearly every case is scrub or fern, but formerly this soil may have supported light forest. Coconut trees grow slowly, few root crops are grown, and even cassava crops give only fair to poor yields.	Surface stones (20%); rapid permeability, profile shallowness, sever seasonal soil moisture deficits; Slight to moderate wind erosion risk; profile stoniness; slight to moderate alkalinity; and very high P retention (high P reserves), zinc deficiency and very low potassium reserve.
NIUE Total		**26,173**		

Sources: Reproduced from Martel 1998, Niue National Forest Policy based on work done by Leslie 1989 and Martel et al. 1997

Appendix ii: Soil Fertility Maps of Niue: Soil Potassium Level

Appendix iii: Soil Fertility Maps of Niue: Soil Zinc Levels



Appendix iv: Percentage of Rock Outcrops in Niue

Appendix v: List of Persons Consulted

	Affiliated Department/NGO
Andre Siohane	Water Supply Division, PWD
Andrew Funaki	Commercial Farmer
Brandon Pasisi	Fisheries, DAFF
Colin Etuata	Quarantine, DAFF
Crossley Tatui	External Affairs, Premiers Department
Dr Siosiua Halavatau	Soil Scientist, DSAP Project, SPC
Ernest Nemaia	Director DAFF
Gaylene Tasmania	DSAP Project, DAFF
Hayden Talagi	Environment Department
Hubert Kalauni	GPS imagery, DJLS
Ida Talagi	Director, Tourism Office
Ioane Mamaia	Vanilla Extension Project, DAFF
Judy Tanevesi	NBSAP Project
Aukuso Pavihi	Niue Island Organic Farming Association (NIOFA)
Metric Ikitoelagi	Forestry Division, DAFF
Morris Tafatu	Market Gardener
Natasha Toeono	POPs Project Coordinator
Pasifika Mautama	Civil Division, PWD
Pualagi Kauapi	Land Surveying, DJLS
Rev. F Liuvaie	National Council of Churches
Rodney Alec	Extension Services, DAFF
Tagaloa Cooper	Department of Environment
Taliu Alapaki	Private Sector
Tea Tukiuha	Vanilla Extension Project, DAFF
Teri-Anne Mokoia	Forestry Division, DAFF
Tina Cooper	Private Sector
Togia Sioneholo	Head of DJLS

Appendix vi: Record of the UNCCD Consultative National Action Plan Workshop

UNCCD NATIONAL ACTION PLAN WORKSHOP
15 SEPTEMBER 2004
ALOFI RUGBY CLUB

PART 1: AGENDA

9:00 am	Opening MC	Ernest Nemaia
	Opening Prayer	Rev. Faulkland Liuvaie
	Opening Remarks	Acting Assc. Minister for DAFF
9:20 am	Overview of UNCCD	Ernest Nemaia
9:40 am	National Action Plan	Felicia Nemaia
10:20 am	***Morning Tea Break***	
10:40 am	Introduction to Working Group Topics	
10:50 am	Working Groups	
11:30 am	Presentations	
12:00 pm	Discussions	
12:30 pm	Closing	

PART 2: RECORD OF PROCEEDINGS FOR NIUE'S NATIONAL ACTION PLAN CONSULTATIVE WORKSHOP FOR THE CONVENTION TO COMBAT DESERTIFICATION

1. Opening Prayer – Rev F Liuvae

2. Master of Ceremony - Ernest Nemaia

3. Opening remarks – Acting Minister J Siakia

4. Presentation – Ernest Nemaia (Overview of UNCCD)

5. Presentation – Felicia Nemaia (National Action Plan)

6. Question: This is UNDP Funded – what is medium size project in terms of money?

7. Reply: US$750,000. Organic Farming is one project that comes into this category.

8. Acting Minister: I am interested in the maps you have, can we get copies of those maps?

9. Reply: Yes - I have them in computer.

10. Felicia explained how plan came about, and proceeded to go through NAP. Now up to people here to either agree or disagree with the Plan then go on from there.

11. Morris T: Is Azotobacter fertiliser readily available?

12. Reply: Not on Niue. You have to be aware of what kinds of condition it will survive in also. Been tested and used in India.

13. Morris T: Has it been used in NZ to gauge whether it is good or not?

14. Reply: I don't know but I will be quite happy to look up all relevant information.

15. Ernest: If applied properly, it should not be detrimental.

16. Kuso: These sub-titles – are they actions we will go through later on in the day?

17. Reply: Yes, and you can either add or delete to these.

18. Ernest: There has been some work done on this area but very small – Agroforestry and Soil Rehabilitation but need to be confirmed. No reason why taro cannot be planted in with nonu plantations. Need to take it further. Mahogany was brought in before. (Also went on to explain meaning of mycorhizae, which is type of fungus), this also would benefit tree growth.

19. Morris T: When we planted *pinus caribbena* we got the soil from the Vaiea Farm to get that mycorhizae element through but again it was inconclusive, whether the result was good or otherwise.

20. Felicia went through rest of her presentation. Questions can be asked at the end of each section. Also explained what different sub-titles meant.

21. Andre Siohane corrected 9.7 – should read Waste Water Management (or 'grey water' eg. waste from the shower, sink and washing machines).

22. Under 9.8 – Education and Awareness – suggestion made that publication of resources in books, fliers, leaflets and video also incorporate into school circular activities

23. Tagaloa made a suggestion that perhaps not just having information available but teaching farmers to understand so that would be a requirement for capacity building.

24. Kuso: Under Specific Sector Requirements – I don't see NIOFA there. It is important that NIOFA be included because we do have our own committee members as well as others who support us in this industry of organic farming.

25. Brandon P: Important to note all of them because in this day and age, funds are given to help the private sector.

26. Tagaloa: It is important to note that there is no guarantee if that sector is put in with departments, they may not work together.

27. Meeting noted there is a need to upgrade institutional strengthening.

28. Tagaloa: What would regional capacity building be?

29. Reply: Training for Diploma and Degree as well as Workshops.

30. Felicia: For this to be an effective plan, we would need to monitor it.

31. Brandon: UNDP are very strict in monitoring and evaluation process.

32. Ernest: It is donor's requirement so funding is used properly.

33. Brandon: Just in terms of funding aspect, does this medium size project requirement incremental because from government, it does.

34. Ernest: It works on a dollar for dollar basis and some are ín kind' – require some country contribution.

35. Tagaloa: Literature research has been difficult and I just want to commend Felicia for this Plan.

36. Ernest: That is a very important point as a lot of projects have been done but we don't have the money to implement them. This is important so some action can be implemented For this work, we are taking it one step further and see if we can action them.

37. Tagaloa: Project has been approved for funding of 3 plans. Need financial resources to implement/fulfil these obligations and project will look at how we can improve it.

38. Crossley: In reality, sizing recommendations for action plan, remember is more than amount of people here on Niue.

39. Morris: That is why it is important to be realistic and make sure what we are aiming for is achievable.

40. Ernest: How can we access that money?

41. Tagaloa: It is going to be a tool to access gaps and identify how we can afford them.

42. Brandon: Want to hear your thinking in terms of how groups going to operate. My view is over-all framework; we come up with suggestions for the project has the potential to carry very big research component in it. Need to identify whether stakeholders want funds targeted, how are we going to pool all these together? What is the process?

43. Ernest: I will let each group deal with the number of actions needed. We know we need to work on the ground addressing issues on ground level so we will focus on that. Maybe some components that may need research.

44. Brandon: A lot of those things we can drive it in the field unless you can demonstrate what you are looking for, what came through when you were going through this because we don't have the information.

45. Ernest: Let us who are here discuss these things, agree and analyse whether feasible or not and if achievable. Perhaps we can break up into 4 groups. Group 1, Cropping and Land Clearing, Group 2 Soil Diagnostic and Soil Rehabilitation, Group 3 – Include Agroforestry/Forestry and Water

Management, Group – Public Awareness and Education/Capacity Building Requirements.

46. Ernest: If one area left, not fallow for over 20 years, you can't go in to those areas.

47. Morris: That would depend on rejuvenation period.

48. Brandon: Should provide incentives. If government has proviso not to go into certain land but it still does not stop the burning and cutting of those areas.

49. Ernest: The policy is there. For example during the drought season, people can work in the uhi.

50. Kuso: Is there anything in the Environment Act?

51. Tagaloa: The Environment Act is quite broad, you can use the Act.

52. Brandon: When you talk about incentives it is different. If you say cost of bulldozer for clearing is half-price, it is hard to gauge. If you have your own set of guidelines so it is clear to follow. If we are talking bulldozer and machinery, this can be controlled.

53. Ernest: The owners of the land can please themselves, no one can tell them what to do.

54. Kuso: As far as government's long term, they are supportive of organic farming and we were mandated to achieve this before year 2010. Therefore, prefer wording as it stands as long as you have integrated word there.

55. Brandon: To add to what Kuso said, it is covered here. What is implicit in this whole document includes all types of farming.

56. Kuso: What about utilising the old village tanks, a lot are broken but can funds be allocated to upgrade or renew them?

57. Ernest: `Are you saying to continue growing mahogany? Is there any economic value in this?

58. Taliu: Yes, there is.

59. Kuso: If you don't spell this out, different people will have different explanations.

60. Tagaloa: There may be no need. Ask for gear if anything, hardware to improve our land and if DAFF misuse this equipment, they will be held responsible.

61. Kuso: Earlier on you were talking about funds from outside sources, for example this is for Women Stakeholder group and Youth. If they don't come in direct to this stakeholder, something is wrong.

62. Tagaloa: If these groups are named as stakeholders they will benefit. It is not actually under every specific private sector requirement, needs it written in as to what acts should decide. Sector Requirement means all sectors. We need to bring our children up to understand it is different levels of awareness for different people.

63. Brandon: It is important to know different things work for different stakeholders, need strategy for different groups.

64. Tagaloa: For women it would be different, it would be ornaments. Strategy for women would have to be different.

65. Brandon: Couple of issues I would like to point out. One, is issue of development of a database for mapping work and making this information available to the farmers. Second Institutional strengthening, building up different aspects because these are groups who will be taking this further. Thirdly, Priority of use of waste water. A report received from SOPAC indicates high level of phosphate going down to the sea so this may have some effect.

66. Andre: This issue was raised at the Reef discussions.

67. Ernest: The figure of 600 litre of water per person per day is a lot. I like this idea to use this greywater. I think this basically wraps up all the discussions. Thank all the participants who attended. Your comments and notes have been noted and will be changed and we will send the Report out to you to have and look and confirm. If there is anything you want to be included, please let us know.

68. Brandon: We have to prioritise all the activities within different sections but we are going to prioritise these areas or you want it all incorporated?

69. Ernest: If there is anything in there you think should be first, then we will push for that.

70. Brandon: All the things we are talking about here we need to know what is in the soil and all other activities follow, what is lacking or deficient in the soil, then work on from there.

71. Ernest: All of these things are linked but you are right, we need to understand first what is happening with our soil. A Report will be coming back to you and we need to finalise it as soon as possible.

Workshop concluded at 2.00 p.m.

PART 3: LIST OF PARTICIPANTS

Venue: Alofi Rugby Club

Date: 15 September 2004

Consultant: Felicia Nemaia

Participants: Ernest Nemaia
Brandon Pasisi
Rev. F Liuvaie
Morris Tafatu
Colin Etuata
Tea Tukiuha
Crossley Tatui
Ioane Mamaia
Andrew Funaki
Gaylene Tasmania
Kuso Pavihi
Rodney Alec
Teri-Anne Mokoia
Natasha Toeono
Andre Siohane
Pasifika Mautama
Taliu Alapaki
Judy Tanevesi
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Appendix vii:	Niue's Environment Act

A BILL

FOR AN ACT to allow for the development of environmental policy and law, to establish an Environment Department and to provide enforcement powers to environment officers.

1 Short title and commencement

This Act may be cited as the Environment Bill 2003.

This Act enters into force on the date it is passed by the Niue Assembly.

Part 1 - PRELIMINARY

2 Interpretation

In this Act unless a contrary intention appears-

"Act" includes its regulations;
"approval" includes any permit, consent or licence;
"Department" means the Environment Department established under Part II;
"development" means any project, undertaking or other activity proposed by any public authority or any other body or person which may significantly affect human health or society, the environment, or use of natural resources;
"Director" mean the Director for Environment appointed under this Act;
"environment" includes all natural and social systems and their constituent parts, including people, communities, and economic, aesthetic, cultural and social factors; OR: ALL ASPECTS OF THE SURROUNDINGS OF HUMANS WHETHER AFFECTING THEM AS INDIVIDUALS OR IN THEIR SOCIAL GROUPINGS
"High Court" means the High Court of Niue;
"judicial officer" means the Chief Justice, a Judge, a Commissioner, or two High Court Justices of the Peace sitting together;
"land" includes:

- all things growing on land;
- buildings and other things permanently fixed to land;
- land covered by water, such as reefs and the seabed of the territorial sea;

"Minister" means the Minister responsible for environmental matters;
"occupier" in relation to any land or premises means any lessee, licensee, or other occupant of the land and includes the owner or the agent; or representative of the owner where there is no apparent occupier;
"public authority" means any Ministry, Department, Division, Board, agency, authority, statutory body, statutory corporation, or administrative office and includes a member of staff or other person who exercises functions on behalf of a public authority;

"rules" includes standards, guidelines, measures, codes of practice, operational procedures and technical specifications;
"sustainable means development that meets the needs of the present generation development" without compromising the ability of future generations to meet their own needs and involves using resources to improve the quality of human life while living within the carrying capacity of supporting ecological systems;

3 Objectives

(1)The objectives of this Act are to:

(a) provide a mechanism for the development of environmental policy and law;
(b) establish an Environment Department; and
(c) provide enforcement powers for environment officers.

4 Matters to be taken into account

(1) All persons exercising functions and powers under this Act shall take into account the following matters:

(a) the maintenance and enhancement of the quality of the environment;
(b) the efficient use and development of natural and physical resources;
(c) the concept of sustainable development;
(d) the protection of the water lens from contamination;
(e)the protection of indigenous flora and indigenous fauna and their habitats;
(f) the protection of the coastal zone from inappropriate use and development;
(g) the protection of historic areas from inappropriate use and development;
(h) the relationship of Niueans and their culture and traditions to their lands and historic areas;
(i) the conservation and sustainable use of biological resources;
(j) the compliance to multilateral environment agreements Niue is a party to.

Part 1 - ADMINISTRATION

Division 1 - The Environment Department

5 Establishment of the Department

The Environment Department is established by this Act.

6 Functions of the Department

(1) The Department, in addition to any function specified elsewhere in this Act, has the following functions:

(a) To administer and implement this Act;
(b) to formulate environmental and resource management objectives;

(c) to facilitate in the formulation on environmental policies and legislation;
(d) to design and implement programmes with line agencies for:
(i) environmental planning and natural resources management;
(ii) environmental impact assessment;
(iii) waste management and pollution control;
(iv) nature conservation;

(v)protection of historic areas;
(vi) such other sectors as may be designated by the Council.

(e) to promote environmental awareness, public information campaigns, and environmental education;
(f) to review environmental legislation, including this Act, and where necessary to propose amendments and regulations;
(g) to monitor, and enforce environmental laws and policies;
(h) to act as a secretariat to the Council.
(i) To oversee the formulation of collaborative policies and programmes with other public authorities and with non-governmental organisations on environmental matters and to advise on, promote, and assist in implementing these policies and programmes;
(j) To promote the study of the environment through research and surveys, listings, classifications and compilation of databases;
(k) To undertake studies and reports;
(l) To promote community involvement in environmental decision making;
(m) To encourage and foster knowledge, innovations and practices embodying traditional lifestyles that promote the protection, conservation, improvement and management of the environment;
(n) To facilitate compliance to and implementation of multilateral environment agreements relating to the environment.

(2) The Director shall set priorities for the work of the Department.

7 Staff of the Department

(1) The Department shall consist of a Director and such other officers to be appointed by the Niue Public Service Commission as may be necessary for the administration of this Act.

Annual Report of the Department

The Director for Environment shall furnish to the Minister a report each financial year regarding the operations of the Department and the discharge of its functions and shall include a copy of the accounts of the Department for that financial year.

Division 2 - Director for Environment

9 Functions of the Director for Environment

(1) The Director is to:

(a)oversee the efficient, effective and economical management of the Department;

(b) give advice to such person as he or she is accountable to on matters concerning any aspect of the environment and concerning any function of the Department;

(c) carry out any other acts he or she thinks necessary to properly discharge his or her functions.

10 Power of Director to delegate functions

(1) The Director may delegate any of his or her functions and powers, other than this power of delegation, to any authorised person.

(2) In this section, an "authorised person" means a member of staff of any government department or statutory authority.

Part 3 - Environment Officers

11 Environment Officers

The Minister may appoint in writing any appropriately qualified person to be an Environment Officer, including police officers, quarantine officers, fisheries officers and public health inspectors.

12 Identification of Environment Officers

(1) Each Environment Officer shall be furnished with an identification card which shall be produced:

(a) if practicable, on each occasion before the Officer proceeds to act pursuant to this Act; and

(b) on demand.

13 Power of Environment Officer to inspect

(1) It is a condition of every approval issued under this Act that the holder must permit an Environment Officer to carry out inspections authorised pursuant to this, or any other Act, of any place, other than a private residential premises, to which the approval relates.

(2) The owner or occupier of any place in respect of which an Environment Officer is exercising powers or carrying out duties pursuant to this or any other Act, shall:

(a) give the Officer all reasonable assistance to enable him or her to exercise those powers and carry out those duties;

(b) furnish all information in relation to the exercise of those powers and the carrying out of those duties that the Officer may reasonable require;

(c) not be required to answer a question or give information tending to incriminate himself or herself and the Officer shall caution such person accordingly.

(3) For the purpose of the administration of this Act, an Environment Officer may at any reasonable time:

(a) enter and inspect any place to which an approval has been issued under this Act to determine whether any activity is being undertaken in violation of that approval;

(b) enter and inspect any place where the Officer has reasonable grounds to believe that documents pertaining to any offence under this Act may be found;

(c) stop and inspect any aircraft, vessel or vehicle to ascertain whether it, or the manner in which it is being operated, complies with this Act;

(d) required the production of any documents that are required to be kept pursuant to this Act or any other documents that are related to the purpose for which the Officer is exercising any power or performing any duty under this Act.

(4) where a judicial officer of the High Court is satisfied on evidence in writing made under oath by an Environment Officer that:

(a) there are reasonable grounds to believe that it is appropriate for the administration of this Act for the Officer to do anything set out in subsection (3); and

(b) the Officer may not be able to carry out duties under this Act effectively without a search warrant issued under this subsection because:

(i) no person is present to grant access to a place that is locked or is otherwise inaccessible;

(ii) a person has denied the Officer access to a place or there is reasonable ground for believing that a person may deny the Officer access to a place;

(iii) a person has prevented the Officer from doing anything set out in subsection (3);

(iv) there are reasonable grounds to believe that an attempt by the Officer to do anything set out in subsection (3) without the order might defeat the purpose of the inspection or cause an adverse effect,

the judicial officer may issue an order authorising the Officer to do anything set out in subsection (3) that is set out in the order, and the order must be exercised within 14 days of the date of issue.

(5) An Environment Officer may not enter a private residential premises except:

(a) with the consent of the owner or occupier; or

(b) pursuant to the authority of any search warrant issued under subsection (4).

14 Power of Environment Officer to Seize

(1) An Environment Officer may, without a court order or a search warrant, seize any thing that is produced to the Officer, or that is in plain view during an inspection under this section, if the Officer, has reasonable grounds to believe that there has been an offence committed under this Act and that the thing to be seized will afford evidence as to the commission of the offence.

(2) An Environment Officer seizing any thing pursuant to the provisions of subsection (1) shall:
  (a) Inform the person of the reason for the seizure;
  (b) Give the person a receipt for the article that has been seized; and
  (c) Remove the seized article to a place of safekeeping and deal with the seized article in the same manner as if it were seized pursuant to the authority of a search warrant.

Division 4 - The National Council of Sustainable Development

15 Establishment of the National Council of Sustainable Development

(1) This section establishes the National Council of Sustainable Development

(2) The Council shall comprise:
  (a) one member from each of the following public authorities: Health. Planning, Police, Public Works, Community Affairs and the Tourism Office;
  (b) two members from Agriculture, Forests and Fisheries;
  (c) a member to be selected by the Chamber of Commerce to represent private sector commercial interest;
  (d) two members to represent interest groups or the community generally, not effectively represented by members in the preceding paragraphs; and
  (e) the Director.

16 Functions of the Council

(1) The functions of the Council are to:
  (a) advise the Minister on environmental, planning, developmental and resource management policies and on ways of resolving conflicts between these policies;
  (b) advise the Minister on draft laws and draft rules;
  (c) advise the Minister on how to resolve conflicts in the implementation of the NEMS;
  (d) review the work of the Department.

(2) Schedule 1 applies concerning the appointment of members and the procedures of the Council.

Part 3 – ENFORCEMENT

17 Civil and criminal jurisdiction of High Court

The High Court has criminal jurisdiction for all offences committed under this Act and civil jurisdiction for all applications and proceedings brought under this Act.

18 Proceedings for restraint of breaches of Act

Without prejudice to the power of the Court to strike out vexatious proceedings, any person may bring proceedings in the High Court for an order to remedy or stop a breach

of this Act, whether or not any right has been, or may be, infringed as a result of that breach.

19 Orders of the High Court

(1) where the High Court is satisfied that a breach of this Act has occurred, or that a breach is likely to occur unless stopped by an order of the High Court, it may make any order it thinks fit to remedy or stop the breach including enforcement orders, declarations, and injunctions.

(2) Where an injunction or other remedy is sought concerning any development, the High Court must order that no person is required to give an undertaking as to damages or to provide security for costs.

(3) The High Court must not award costs against a person who brings proceedings to stop any development or who asks for any other requiring compliance with tis Act unless the High Court is satisfied that the person has acted maliciously in bringing the proceedings and that the proceedings have no merit.

20 Civil claims for environmental damage

Notwithstanding the results of any criminal proceedings arising under this Act, a person who has suffered loss as a result of any environmental incident may bring civil proceedings which may include a claim for:

(a) economic loss resulting from a pollution incident or from activities undertaken to prevent, mitigate, manage, clean up or remediate any pollution incident;
(b) loss of earnings arising from damage to any natural resource;
(c) loss of any natural environment or resource.

21 Common law causes of action

Common law causes of action are preserved under this Act.

Division 2 - Environmental Offences

22 Limitation period for offences

(1) A prosecution for an offence under this Act may not be commenced more than 3 years after:

(a) the date on which the offence was committed; or
(b) the date on which the evidence of the offence first came to the attention of the prosecuting body,

whichever is later.

23 Offences

(1) Any person who:

(a) provides false or misleading information pursuant to a requirement under this Act to provide information;
(b) does not submit any report or provide information as required pursuant to this Act;
(c) submit any false or misleading report in respect of any tests or inspections required pursuant to this Act;
(d) hinders or obstructs an Officer who is exercising powers or carrying out duties, or attempting to do so, pursuant to the requirements of this Act;
(e) fails to give all reasonable assistance to an Officer who is exercising powers or carrying out duties, or attempting to do so, pursuant to the requirements of this Act;
(f) offers or gives any inducement to any person exercising functions and powers under this Act which might reasonably be considered to have the purpose of influencing a decision of that person under this Act;

(g) fails to comply with any approval, requirement or condition imposed under this Act;
(h) fails to comply with any approval, requirement or condition imposed by any public authority pursuant to the provisions of this Act;
(i) does not comply with the terms of any order of the High Court made under this Act and served on that person;
(j) is guilty of an offence and liable to a fine not exceeding $10,000.00 or to a term of imprisonment not exceeding 12 months, or both such fine and imprisonment.

(2) Where an offence under this Act is committed or continued on more than one day, the person who committed the offence is liable to be convicted for a separate offence for each day on which the offence is committed or continued.

24 Liability of company

(1) If a company fails to comply with any provision of this Act, each person who is a director of the company or who is concerned in managing the company, is taken to have failed to comply with that provision, unless the person satisfied the High Court that:
(a) he or she has no actual, imputed or constructive knowledge of the failure by the company to comply with the provision; or
(b) he or she was not in a position to influence the conduct of the company concerning its failure to comply with the provision, or, if in such a position, he or she used all due diligence to prevent the failure to comply by the company.

(2) If a company fails to comply with any provision of this Act, each person who is a director of the company or who is concerned in managing it may be proceeded against and convicted whether or not the company has been proceeded against and whether or not it has been convicted.

(3) The company remains liable for any offence committed by it whether or not proceedings are commenced against the directors or those concerned with managing the company.

25 Company liability in case of bankruptcy

Where any company commits an offence under this Act, any penalty or award of environmental damages against that company shall take precedence over any secured or preferred claim lodged in any action for bankruptcy against that company.

Division 3 - Additional Penalties for Environmental Officers

26 Additional Penalties

(1) The High Court may, in addition to any other punishment that may be imposed under this Act and having regard to the nature of the offence and the circumstances surrounding its commission, make an order:

(a) for temporary or permanent closure or suspension of any activity or facility or cancellation or modification of any approval if the activity pollutes or damages human health or the environment beyond the limits set forth by this Act;
(b) for indemnification of the Government, occupiers, or any person whose interest is affected by the damage caused to the environment or to human health;
(c) for replacement and restitution to their natural state of things affected;
(d) for rehabilitation of the environment affected at the cost of the party responsible for the offences;
(e) directing the offender to compensate any affected party, in whole or in part, for any environmental damage or the cost of any remedial or preventative action taken or caused to be taken as a result of the act or omission that constituted the offence;
(f) prohibiting the offender from doing any act or engaging in any activity that may result in the continuation or repetition of the offence;
(g) directing the offender to take such action as the High Court considers appropriate to remedy or avoid any harm to the environment that results or may result from the act or commission that constituted the offence;
(h) directing the offender to post such bond or pay such amount of money to the Unit or into Court as will ensure compliance with any order made pursuant to this section;
(i) directing the seizure and forfeiture of any vessel, aircraft, or vehicle used in the commission of any offence;
(j) requiring the offender to comply with such other reasonable conditions as the High Court considers appropriate and just in the circumstances.

(2) Where an offender has been convicted of an offence under this Act, the High Court may, at the time the sentence is imposed and on the application of the person aggrieved, order the offender to pay to that person an amount by way of satisfaction

or compensation for loss of or damage to property or income suffered by that person as a result of the commission of the offence.

(3) Where an amount that is ordered to be paid under subsections (1) or (2) is not paid within the specified time, a civil judgement may be filed with the High Court of Niue, and that judgement is enforceable against the offender in the same manner as if it were a judgement rendered against the offender in the High Court of Niue in civil proceedings.

(4) The High Court may in addition to any other punishment that may be imposed under this Act impose a fine for each day the offence continues until compliance is fulfilled.

27 Community Service Orders

(1) Upon the conviction of any person, the prosecution may make submissions to the High Court on the appropriateness of a Community Service Order and of the availability of any community service work.

(2) The High Court may sentence a person to a Community Service Order instead of or in addition to a fine.

(3) The High Court may order a person sentenced to a Community Service Order to work under appropriate supervision a specified number of hours for a charitable or community cause or organisation, and where possible, the work should relate to environmental matters.

(4) The High Court may specify whether the Director, a police officer or some other person is to supervise the Community Service Order work.

Part 4 - MISCELLANEOUS

28 Application

(1) This Act applies to all areas under the jurisdiction of Niue.

(2) This Act applies to all persons, whether incorporated or unincorporated.

(3) This Act binds the Crown.

29 Effect of this Act on other Acts

(1) The provisions of this Act apply even if they are inconsistent with the provisions of any other law.

(2) Compliance with the requirements of this Act does not relieve a person from separate compliance with any other law of Niue.

(3) This Act overrides any approval given under any other law or public authority.

(4) Law, for the purposes of this section, does not include the Constitution.

30 Non-exemption from environmental management responsibilities

This Act does not exempt other public authorities from the execution of their environmental management responsibilities.

31 Environment Officers not personally liable

The Director, Environment Officers, staff of the Environment Department, members of the Council and authorised persons are not personally liable for anything done or omitted to be done in performing their functions in good faith under this Act.

32 Regulations

(1) Cabinet may from time to time make all such regulations as may be necessary or expedient for giving effect to the provisions of this Act and for its due administration.

(2) Without limiting the generality of subsection (1), regulations may be made:

(a) prescribing the procedures and requirements for an environmental impact assessment;
(b) providing for planning and natural resource management;
(c) prescribing waste management and pollution control measures;
(d) providing for the regulation of hazardous substances;
(e) providing for the regulation of hazardous wastes;
(f) prescribing for the identification of species to be protected and their habitats;

(g) prescribing rules for the introduction or control of alien or non-native species;
(h) providing for the protection, preservation and management of historic areas;
(i) providing for the rehabilitation of any contaminated or polluted land.

This Act is administered by the Environment Department.

Appendix viii: Effluent: Turning Waste Into a Resource

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INTRODUCTION

Improvements in the management of effluent could result in major environmental and economical benefits to larger and smaller communities: - reduce the use of water from natural systems; remove a major source of bio-available nutrients to receiving waters; facilitate bio-remediation of contamination; facilitate soil rejuvenation and provide alternative fertilizers, mulch and topsoil.

This paper will examine the characteristics of biosolids, problems and opportunities for re-use in Niue.

WHAT ARE BIOSOLIDS

Biosolids and greywater contain useful nutrients and organic matter, however they also contain pathogens and sometimes-toxic metals (Barbarick, 1998). Misuse of effluent nutrients particularly nitrogen and phosphorus can degrade ecological systems including the water table, stream, rivers, dams, estuaries and marine areas.

Biosolids are the components of sewage that contain the solids. Historically they were referred to as the sewage 'sludge'. Barbarick (1998) describes biosolids as the "accumulated residual product resulting from a domestic wastewater treatment works. Biosolids does not include grit or screenings from a wastewater treatment works, grease, commercial or industrial sludges or domestic or industrial septage." Sludge could be used to describe the 'solids' components of septic tanks, sealed units, advanced water treatment systems (AWTs), moist and dry composting systems and absorption disposal systems. Generally biosolids are the nutrient-rich organic material resulting from the separation of greywater and chemical, biological and physical degradation of sewage. Biosolids if considered as the concentrate form of the sewage are rich in nutrients, with Nitrogen (N), Phosphorus (P) and trace elements such as Sulfur (S), Magnesium (Mg), Iron (Fe) and zinc (Zn).

Biosolid re-use through land application provides a means to return nutrients and organic matter to the soil. Land disposal of effluent and other wastes is attractive in the context of ecologically sustainable development, however, we must be sure we are not just transferring problems from point source to nonpoint source or threats to the groundwater or other systems (Cullen 1995, Dillon and Schrale 1993).

PROSPECTS FOR NIUE

Niue has a population of 1800, with approximately 1200 occupied dwellings. Dwellings have augmented water supply and use either septic tanks or 'long drops' for effluent disposal. These are generally in poor condition and regular pump outs are required. This untreated effluent is currently dumped at a site that is most likely a former cave. This practice is not good for

environmental health and water resource protection reasons. Effluent including biosolids is currently seen as a waste in Niue, rather than a resource.

Niue is an uplifted coral atoll whose soils, while fertile in some parts, lack certain constituents and trace elements. Physically the soils suffer a lack of depth (up to 50% rock outcropping for most of the island). Niue is remote and synthetic fertilizer and agricultural chemicals are very costly. The porosity and permeability of the sub-soil and substrate is such that nutrients leach very quickly.

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 topsoils, which created K, Mg and Ca imbalances and restricted the uptake of essential nutrients by plants. These areas have become overgrown with ferns or remain as bare earth areas. Widowson (1979) summarised the problems with calcium carbonate enrichment of topsoils in subsistence farming environments:

- It decreased organic matter which in turn reduces water holding capacity and nutrient supply, leading to structure decline;
- It is low in plant nutrients (other than Ca and Mg) and dilutes the overall nutrient status of the top soil;
- It reduces the plant uptake of K and Mg;
- It increases pH which decreases the availability of minor nutrients especially Zn, Fe and Manganese (Mn).

Other soil studies have revealed the following characteristics of Niue's soils:

- N is low in all soils;
- Ca and Mg are abundant in all soils;
- P is high and adequate for crop growth, but other deficiencies may inhibit uptake;
- K is low in most soils and is likely to limit crop growth;
- Of the trace elements, zinc is consistently in short supply.

Given the high cost of synthetic fertiliser, an alternative source of nutrients using biosolids could be feasible. Demands are also made for low cost compost, mulch, natural fertiliser and top soil for a number of emerging or intensifying land uses: new golf course (top soil and fertiliser), quarry remediation, vanilla and nonu plantations (mulch beds), 'green' agriculture (for green labelling – mulching), soil rejuvenation (old disc plough areas) and infrastructure service rehabilitation. The opportunities are therefore open for biosolid use in broadacre and site specific applications.

PROBLEMS and PROSPECTS for BIOSOLID USE

The primary concern with re-use in terms of human health is the control of pathogens. The choices in disposal of sewage sludge historically has been (GHD Pty Ltd, 1992):

- Aerobic digestion;
- Anaerobic digestion;
- Incineration;
- Disposal in a sanitary landfill;
- Ocean dumping;
- Dried and used as a fertiliser;
- Composting.

Barbarick (1998) describes other possible treatments in addition to the above:

- Heat treatment;
- Thermophilic aerobic digestion;

- Beta ray irradiation;
- Gama ray irradiation;
- Pasterurisation;
- Lime stabilisation.

Barbarick (1998) explains that use of lime to increase the pH of biosolids is an effective means to control pathogens. Niue has plenty of calcium carbonate, which makes this option very feasible. Methods employed will need to be guided by best practices. The USDA (in Barbarick, 1998) and NSW EPA & Ors (1996) provide guidelines for quality achievement based on the intended disposal methods and end land use.

Current forms of disposal of effluent (including biosolids) are at the dwelling or at a cave (with pumped out materials). In terms of leaching nutrients this may create health problems either locally or in the water lens, especially given the very high permeability of soils. A high concentrate of nitrate ($NO^{-}3$) in drinking water is known to form compounds, which may be carcinogenic (Laws, 1993). Nitrate, which breaks down to nitrite ($NO^{-}2$), absorbs into the blood and forms a pigment, which is unable to transport oxygen. So continuing uncontrolled recharging of the water lens used for water supply could present a danger to the community.

Nitrogen is a plant growth stimulant used in the production of plant protein and therefore is a good component of many fertilisers. The uptake of nitrogen by plants is directly related to productivity (Laws, 1993). However Nitrogen removal by the soil-vegetation complex can be of concern, as nitrate does not readily absorb to soil particles (Laws, 1993). Nitrogen is very mobile and excess nitrogen application in effluent or biosolids can leave a site through leaching to groundwater's (Laws 1993). Care can be taken through disposal site management strategies to reduce the concentration in soils and groundwater by balancing application with chosen crop uptake. Methods may include the removal of vegetation litter, extension of irrigation areas during winter or wet seasons (water balance modeling), and crop or grass species choice (chemical balance modeling) (Laws 1993, NSW EPA, 1993, GHD Pty. Ltd., 1993).

No work has been undertaken in Niue on crop or plant uptake of Nitrogen, however the consensus is that taro and other root crops take up large amounts of N.

Biosolids have been found to be an excellent form of fertiliser as N and P are slowly released following application as they are bound to organic matter (GHD Pty Ltd, 1992). Laws (1993) also notes the prospects of land application as a means to reduce dependence on synthetic fertilisers. He warns however of the tendency for rapid percolation of effluent through the soil, especially during wet periods, beyond the capacity of the root systems to uptake nutrients. Research may be needed in Niue to equate suitable application rates against the determined uptake of N by taro and other root crops, keeping mind seasonal geo-hydrological cycles. If biosolids were used as an alternative fertiliser in Niue supplementary use of Potassium would be needed as biosolids are low in K (Laws 1993).

Phosphorus also is essential for plant growth and applications are readily fixed in soils or uptaken efficiently by the soil-vegetation complex (Laws 1993). On the other hand excessive soil phosphorus levels can reduce the availability of other elements essential for plant growth such a copper, iron and zinc particularly in alkaline soils.

Phosphorus is added to the soil predominantly as orthophosphate ion in the biosolid and if not uptaken by crops, can accumulate, or be lost from the system in deep percolation or by erosion of soil. Phosphorus can also be returned to the soil by the decomposition of plant litter if plant produce is not removed. As with N, careful site management strategies need to be implemented to balance application rates against plant uptake rates.

Efforts for soil rejuvenation and enhancement in Niue may be assessed through the re-use of biosolids. High organic matter levels in biosolids will assist soil structure as well as nutrient and moisture retention in the soil. Excessive amounts of organic matter or suspended solids may clog the surface soil leading to a reduction in infiltration rates. However their situations would be rare

in Niue where the topsoils are typically calcareous. If in the event that excessively organic loadings do arise, such conditions can be rectified by cultivation and increased aeration of the soil (Laws 1993).

CONCLUSION

There are certainly good opportunities for biosolid use in Niue, given previous degradation; soil fertility and structure deficiencies and emerging land uses. However more detailed feasibility studies and baseline surveys would be needed. Other than the problems and prospects outlined above, factors needing consideration would include variations to soil and landscape characteristics: topography, permeability, soil moisture content, soil texture and structure, problems with odour, location of water bores and proximity of dwellings. Baseline information to assess locational and intensity matters should include:

- Continuous meteorological data and infiltration tests to enable water balance modeling;
- Soil variations in terms of soil type, infiltration capacity, hydraulic conductivity, soil depth and groundwater depth;
- Agronomic assessment of taro and other root crop nutrient uptake;
- Monitoring and measurement of wastewater characteristics including TDS, electrical conductivity, major ions (sodium, calcium, magnesium, choride, carbonate, sulfate, potassium, fluorine, boron), metals and chlorinated organics.

Once baseline information is collected modeling using best practices (e.g. NSW EPA 1993) could be undertaken to consider appropriate:

- Hydrologic loading rates.
- Organic loading rates.
- Nutrient loading rates.

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