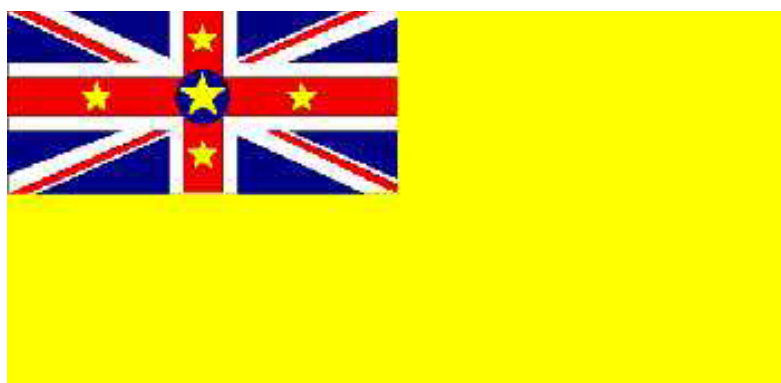


Country Pasture/Forage Resource Profiles

NIUE



by

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CONTENTS

2. CLIMATE AND AGRO-ECOLOGICAL ZONES	5
3. SOILS AND TOPOGRAPHY	6
4. RUMINANT LIVESTOCK PRODUCTION SYSTEMS	7
Cattle	7
Goats	8
5. CONSTRAINTS TO DEVELOPMENT OF PASTURE-BASED LIVESTOCK PRODUCTION SYSTEMS	8
6. THE PASTURE RESOURCE	9
6.1 Improved grass species	9
6.2 Improved legume species	9
6.3 Weed control	9
6.4 Recent initiatives in forage improvement	10
7. RESEARCH AND DEVELOPMENT ORGANIZATIONS AND PERSONNEL	10
8. REFERENCES	10
9. CONTACTS	11

1. INTRODUCTION

The Island of Niue is in the South Pacific (19° S and 169° W) in the middle of a triangle formed by Tonga, Samoa and the Cook Islands. Niue is a raised coral atoll, the largest and highest in the world with a coral reef fringing its elevated coastline. It has a total land mass of 258 km² in area with a coastline circumference of 64 km (Douglas and Douglas, 1989) – see Figure 1. Of the total land area in Niue about 20 400 ha are available for agriculture.

Niue is a self-governing Commonwealth country with an elected 20-member Parliament, in free Association with New Zealand. The administrative centre is Alofi, on the west coast. Niueans are Polynesians, and the provisional population estimate was about 1 700 in 2001 (Niue Statistics, 2001) and 1 625 at the last census in 2006, although the 2008 World Factbook (July 2008) estimate was 1 444 with a population growth rate in 2008 of -0.032%. According to the latest SPC data (SPC, 2008) the mid-2008 population estimate was 1 549 and mid-2010 estimate is 1 476 with a population growth rate for 2008-2010 of -2.4%. The population of the island continues to drop, from a peak of 5 200 in 1966 to 2 100 in the late 1990s and around 1 500 in 2008, with substantial emigration to New Zealand. The number of Niueans living in New Zealand and other countries is about treble those resident in the island. The population of Alofi, the administrative centre was estimated to be about 900 in 2001 (Crocombe 2001). Niueans are bilingual, speaking Niuean and English.

Niue relies greatly on agriculture for its income and food security. The productive ventures in agriculture and livestock are carried out by the public sector, under the guidance of the Department of Agriculture, Forestry and Fisheries (DAFF). The Niue Development Board has been responsible for planning and execution of schemes for the production of lime juice, passion fruit pulp and juice, honey, copra and reconstituted milk. During the last five years focus has been on vanilla (*Vanilla tahitiensis*), kava, Nonu (*Morinda citrifolia*) etc. and DAFF has been very active in assisting farmers with these crops by facilitating them to become certified organic producers, as overseas markets are very attractive for these organic foods. Honey production has been managed by a private entrepreneur and this product is also on the verge of receiving organic status. The main livestock owned by islanders are pigs, poultry and a few cattle. In the past (1960s) cattle in fenced blocks were used to control weeds under coconuts or on unoccupied homestead areas. These cattle, mainly *Bos indicus* crosses were managed for beef. Twenty Herefords from New Zealand were imported in 1992 for cross-breeding with local stock (mainly crossbred Friesians, Brahmans, Santa Gertrudis etc.), but this was not successful. In 1996 the government cattle farm at Vaiea was relinquished to a private company (Niue Alpaca Quarantine Station) and most cattle at the farm distributed to potential growers in the public sector. Some sheep were imported as sentinels for the newly formed Quarantine Station. Table 1 presents statistics of livestock numbers and imports for the period 1997–2007.



Figure 1. Map of Niue

Source: World Factbook

2. CLIMATE AND AGRO-ECOLOGICAL ZONES

The overall climate of the island may be described in general terms as hot and moderately wet. In view of the gentle relief of the whole island and because of the lack of high mountains and the small size of the island there are few climate changes or differences, except between dry and wet season. Climate is influenced by the southeast trade winds that prevail for most of the year, especially from May-December. The wet season extends from November to April and the dry season from May to October, but in some years there is little difference in rainfall between the two seasons. The ocean around Niue ensures a fairly equable temperature throughout the year. The annual minimal temperature is 21.3 °C and the maximum is 28.33 °C with an average temperature of 23–24 °C (Robinson, 1981).

Table 1. Niue statistics of livestock numbers, fresh milk and cattle and beef and veal imports for the period of 1997–2007.

Item	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Cattle (head)	80	50	30	30	(112)	(112)	(112)	(112)	(112)*	(112)	(115) <10 ***
Goats (head)	5	5	5	5	n.r	n.r	n.r	n.r	n.r	n.r	n.r
Sheep (head)	6	6	6	6	n.r	n.r	n.r	n.r	n.r	n.r	n.r
Pigs (head)	(1 800)	(1 800)	(1 800)	(1 800)	(1 900)	(1 900)	(1 900)	(1 900)	(2 000)	(2 000)	(2,100)++ 1 164**
Cattle Imports (head)	n.r	n.r	n.r	n.r	n.r	n.r	n.r	n.r	n.r	n.r	n.r
Milk fresh imports (Mt)	40	40	40	40	40	29	31	27	31	50	n.r
Beef & veal imports (Mt)	10	10	10	2	1	2	3	3	-+	1+	n.r

* Livestock numbers from Niue data except numbers in () from FAOSTAT

** Source: figures from the 2006 population and housing census

*** Estimate for 2007 and 2008 (S.G. Reynolds)

+ Other meat imports include (for 2005 and 2006 respectively) 12 and 35 Mt of beef preparations and 50 and 79 Mt of chicken meat; total meat imports in 2005 and 2006 were 66 and 128 Mt respectively.

++ there are also many wild pigs but exact numbers are not known

n.r = no record

No data for 2008 except for the estimate for cattle numbers

Sources: DAFF Niue data (Misikea); FAO on-line statistics

As Niue has no central mountainous region (the highest point is 68 masl), the trade winds blow more or less uniformly across the island with the result that there is no marked differentiation between windward and leeward aspects. Although, the wet season is usually from December to April, dry periods can occur at any time.

Annual rainfall averages 2 075 mm and during each of the dry months rainfall varies between 80-140 mm. In the wet season it exceeds 260 mm average rainfall on at least 10 days a month. There is little annual variation in rainfall and in most years it is sufficient.

Tropical rainforest once covered Niue, but human habitation has substantially modified the original vegetation. Primary forest is now reduced to remnants in the central, east and southeast districts. Outside the zones of primary forest are stands of secondary forest, scrub and shrub communities. Also, another extensively modified and degraded plant community is the 'Niuean desert' or fernland area produced as a result of prolonged cropping and soil impoverishment.

3. SOILS AND TOPOGRAPHY

Niue Island is an elevated coral atoll uplifted by a series of volcanic disturbances to form terraces of exposed coral limestone that subsequently were partly covered by a thin layer of volcanic ash. There are four main soil types in Niue and these are:

- (1) Hikutavake: outer fringe of the island
- (2) Hakupu: coconut/pasture soil
- (3) Fonuakula: pasture soil, and
- (4) Palai: forestry soil, root crops.

For a generalized picture of the soils of Niue see Figure. 2 and Wright and van Westerdorp (1965). The soils differ in texture and colour but have similar pedological organization comprising a thin layer of topsoil over subsoil with makatea 'floaters' of limestone outcrops. The soil series can be differentiated by the subsoil colours. These colours range from very dark grey, through brown and reddish brown to dark red. All soils have low water holding capacity due to high

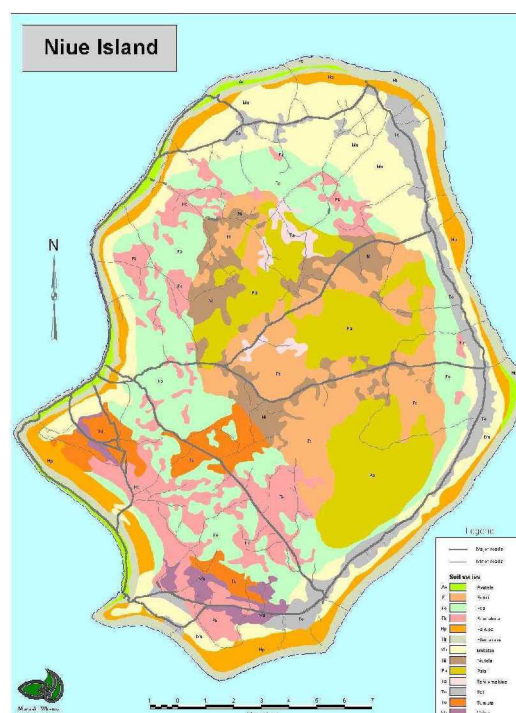


Figure 2. Generalized soil map of Niue
(Copyright Government of Niue)

porosity of the soil and the nature of the substrata material - clay content, low bulk density and shallow depth.

The soils of Niue in general are well supplied with phosphorous and potassium, but there are a few areas that are deprived of these nutrients for plant growth which makes crop production difficult. Some soils also lack nitrogen as can be seen by the yellowing of leaves on some vegetation. Burning of some areas for cropping is common and this may be the reason why some areas are deprived of nitrogen. The supply of calcium, magnesium and many of the trace elements seems adequate for plant growth in most areas. Wright and van Westerndorp (1965) also observed that the soil of Niue is probably derived from volcanic ash. Niue is an upthrust coral atoll which was raised to the surface during underground volcanic action centuries ago.

The soils are very well drained. Indeed so porous is the limestone of the island that there are no surface streams, no surface water or any areas of impeded drainage.

The shape of the land surface has a strong influence on the soil and land use possibilities. Niue can be regarded overall as flat, though in micro-topography it is uneven and broken. Coral limestone outcrops are recognized on roadsides and on the sea line of the island and these show the roughness of the island. Wright's survey concluded that 48% of the surface is occupied by outcrops of hard reef rock.

4. RUMINANT LIVESTOCK PRODUCTION SYSTEMS

The island used to have both cattle and goats on government farms, but the establishment of the Offshore Alpaca Quarantine Station led to government selling all stock to individual farms. The number of animals distributed to each individual depended on the availability of fodder on their coconut and other areas. Earlier government recognized that ruminant livestock would provide income as well as serving to control weeds. Although fresh (goat) milk may only be available to a few individuals (by 2007 and 2008 even this may have stopped), earlier local milk and meat were available in larger quantities.

Cattle

In the 1960s, the herd comprised about 600 head of cattle (and this included 500 breeding cows), with the number rising to about 700 head at one time. However, problems such as prolonged drought, animal rustling, high transportation costs, and high mortality rates gradually reduced numbers and by 2000 there were <50 animals left (see Table 1) and by 2007 and 2008 numbers were probably less than 10. Initially cattle blocks were established throughout the island (in 8 villages and areas), but in the early 1980s cattle were centralized in Vaiea farm until in 1996 animals were again distributed. From the initial Friesians milk was produced in the 1960s and 1970s, but low hygienic standards and other factors brought this to an end and the focus was then mainly on beef production. Breeds included Santa Gertrudis, Herefords, Brahmans, Friesians and Jerseys. Herefords were introduced mainly for crossbreeding purposes and were not well suited to the climate. The future for the very small cattle industry will probably revolve around Brahman crosses with Herefords and with Friesian/Santa Gertrudis crosses. As indicated, the cattle from the Niue Development Board (Airport and Vaiea) Farm (Van der Zwagg, 1980) were subsequently all privately owned and mostly tethered with individual farmers having up to 5 animals, which they rotated around their land. Government responsibility is limited to ensuring the health of the animals and providing AI and bull services when requested. By 2007 and 2008 total cattle numbers on Niue were estimated to have declined to <10.

Previously there were two systems of animal production: (1) intensive/commercial and (2) extensive/subsistence production systems. The intensive/commercial production system was used by the government. Under this system the cattle grazed on the only farm on the island, a 240 acre farm in 18 blocks. However, when the government realized the financial costs of maintaining the farm and with the planned Offshore Alpaca Quarantine Station, the remaining cattle were either slaughtered or distributed to local farmers. Most of the distributed animals were breeding cows while the breeding bull was and is kept by government under DAFF supervision. There is some debate as to whether natural breeding using the bull or artificial insemination (AI) is the best way to go in future.

Individual farmers practice the extensive or subsistence production system. The farmers were given between 1–5 cows depending on the individual farmer's capability. Under the individual farmer scheme, the cattle were also used to graze under the coconut plantations since tractor-drawn slashing operations were not available to farmers with coconut groves and farmers also used the cattle to get rid of weeds in areas that the mower could not get to. All cattle owned by farmers were generally tethered and each farmer can slaughter his cattle for private use.

Goats

Goats were introduced into Niue in the late 1980s, but compared to cattle they did not appeal except as weeders around the homestead. Even after tasting tests organized by DAFF, Niueans had little liking for goat meat and therefore the government of Niue did not import many goats for keeping or for distribution to individuals. Goat production was on a very small-scale and there were (in 2000) only 5 goats and by 2007 there was no record of any goats.

Kiko breed goats from New Zealand were originally introduced in 1985, although Van der Zwagg (1980) mentions Anglo-Nubian goats introduced from Fiji for crossbreeding. All goats were owned by individual families and were tethered, grazing near roadsides in villages and around the homesteads. Goats were used mainly to graze in areas that were impossible for the mower to clean. Given the fragile nature of the atoll vegetation and ecosystems, goat keeping was/is rather problematic and care was taken to ensure that they did not escape and become feral. For this and other reasons such as the cost of fencing and management, government decided not to continue with earlier goat projects such as work started under a UNDP/FAO regional project.

5. CONSTRAINTS TO DEVELOPMENT OF PASTURE-BASED LIVESTOCK PRODUCTION SYSTEMS

In the 1960s in the initial stages of the government focus on developing a cattle programme, pasture was established in a number of areas following meetings with village councils and landowners. Cattle blocks were established throughout the island with lease fees to landowners. Initially the programme was quite successful and in addition legume seed (such as Siratro) was collected from the paddocks and exported. Originally the main interest was to export beef, but this was not practical. With prolonged droughts and reduced pasture growth it was necessary to slaughter many animals and pasture maintenance with inputs of fertilizers and herbicides became too expensive. The development of pasture then and now is difficult and the high costs involved for purchase of expensive fertilizers and chemicals generally dissuade further developments. Probably hand planting of grasses like Koronivia (*Brachiaria humidicola*) and Setaria (*Setaria sphacelata*), although labour-intensive represents the most appropriate method to use, and with the need to protect the underground water lens herbicide use is now discouraged and much less fertilizer is used in cropping generally. Most coconut areas with cattle already have established pastures of guinea grass (*Panicum maximum*), elephant or napier grass (*Pennisetum purpureum*) and Siratro (*Macroptilium atropurpureum*).

Unavailability of land is also a major problem. The Government and individual families own the land in Niue. Under this system land for pasture development is difficult to obtain.

If land is requested for pasture development, landowners often demand a high lease rate.

Instead these families would rather put their land into other good use such as for the cultivation of cash crops that will give them regular income in less than 6 months. Most of the families want fast financial returns, therefore they don't lease their land for pasture development.

The soil and topography of the island is also a constraint to the development of pasture based livestock production systems. Niue is known to be rugged and up to 48% of the island consists of coral rock outcrops that considerably restrict agricultural development. Soil fertility, shallowness, and soil pH vary over short distances, and these factors influence the pastures and cause considerable variability.

With all these factors, and with its past experience, government would have reservations about the development of pasturelands and would carefully weigh the costs against the likely benefits when considering any future investment in pasture development programmes.

6. THE PASTURE RESOURCE

There are a number of naturally occurring grasses and legumes in Niue that could provide feed for grazing ruminant livestock. The natural and improved grasslands in Niue consist of guinea grass (*Panicum maximum* var. *Trichoglume*), napier or elephant grass (*Pennisetum purpureum*), batiki grass (*Ischaemum ciliare*), Koronivia grass (*Brachiaria humidicola*), Setaria (*Setaria sphacelata*), and Signal grass (*Brachiaria decumbens*), probably all of which were introduced at some time in the past. Pasture improvement over the years has been carried out in the village schemes, but these have largely failed partly because of massive weed invasion (Van der Zwaag, 1980), prolonged drought and high costs. However, there are improved grasses and legumes that have established throughout the island and which are available for grazing by livestock; these have mainly resulted from various introduction programmes.

6.1 Improved grass species

Pasture improvement in Niue can be traced back to the initial stages of cattle development programmes in the 1960s. Grass seeds were imported, mainly from Australia and were sown during the wet season in the cattle blocks after land preparation (DAF, 1984). Excellent pastures based on guinea grass/green panic (*Panicum maximum* var. *Trichoglume*) and Sirato (*Macroptilium atropurpureum*) and also the planting of signal grass (*Brachiaria decumbens*) and batiki grass (*Ischaemum ciliare* syn. *I. indicum*) was a means of improving the natural grasses in Niue for better animal performance (Lucas, 1967; Arrighi, 1979; Dale, 1981). Koronivia and Setaria mixed with Siratro demonstrate good competition with weeds, but Koronivia is not particularly palatable, and cattle tend mainly to graze the new growth after slashing. Signal grass, palisade grass (*Brachiaria brizantha*) and batiki particularly, showed excellent ability to compete with weeds. This characteristic is important for the pastures of Niue because weed invasion can be serious. Batiki though is not very drought tolerant. The improved pasture species available in Niue include the following: *Panicum maximum* cv. Green Panic; *Panicum maximum* cv. Hamil grass; *Paspalum plicatulum*; *Brachiaria decumbens*; *Urochloa mosambicensis*; *Chloris gayana* cv. Pioneer; *Chloris gayana* cv. Katambora and *Melinis minutiflora*. Others tried have included: *Cenchrus ciliaris* cv. Biloela; *Cenchrus ciliaris* cv. Numbank; *Cenchrus ciliaris* cv. Gayndah; *Cenchrus ciliaris* cv. U.S.A; *Cenchrus ciliaris* cv. Molopo (Aue, personal communication).

6.2 Improved legume species

There are quite a number of legumes in naturalized fallow (Dale, 1981, Arrighi, 1979, Hutton, 1962) and improved pasture species available in Niue that are used in grass/legume mixtures for ruminant livestock. Today the improved legume species found in Niue (Aue, personal communication) include the following: *Stylosanthes guianensis* cv. Verano stylo; *Stylosanthes humilis* cv. Townsville; *Dolichos axilaris* (Archer); *Desmodium intortum* (Greenleaf); *Dolichos lablab* cv. Rongai; *Dolichos lablab* cv. Highworth; *Dolichos uniflorus* (Leichardt); *Phaseolus lathyroides* (Phasey Bean), *Macroptilium atropurpureum* (Siratro) and Centro (*Centrosema pubescens*).

6.3 Weed control

Various kinds of weeds are found, and at the moment several control methods are used, mostly against the exotic noxious weeds. These include: Giant Sensitive Plant (*Mimosa invisa*, wedelia (*Wedelia* spp.), and chain of hearts (?). Methods to eradicate the weeds include: a) the use of chemicals, b) slashing and burning, c) limestone covering of the affected areas, and d) mechanical or tractor slashing. Chemicals used included Gramoxone, Roundup, Garmex (pre-emergence), but the government is now very cautious and discourages chemical use because of the dangers to health and to avoid contaminating the groundwater lens. Manual control is very laborious and time consuming, but it is the only cheap way

to keep weeds at least temporarily under control for the small-scale farmers. The most common weeds found in Niue are: *Sida acuta*, *Stachytarpheta jamaicensis*, *Tithonia diversifolia*, *Cyperus rotundus*, *Euphorbia hirta*, *Chrysopogon acidulatus*, *Eleusine indica*, *Psidium guajava* (Guava), Honolulu rose (*Clenodendrum fragrans*), *Mimosa pudica* and peanut weed (*Cassia tora*).

Among the weeds found in Niue, *Stachytarpheta jamaicensis* is however, the major problem weed (Atkinson, 1975). The destruction of this weed has proved very costly, as the chemicals used to eliminate it affect grasses and legumes as well. There are no remedies to eliminate this weed, but the Agriculture Department has tried various methods for its total elimination – including hand weeding of 500 acres under contract, tractor slashing etc., but seeds already in the ground germinated again and slashed plants simply resprouted! Much emphasis on weed control at present is placed on tractor slashing. However, attempts are underway to reduce weed infestation by planting grass species that are more competitive with weeds and emphasis is also being placed on suitable management strategies (such as rotational grazing).

6.4 Recent initiatives in forage improvement

The Agriculture Department has carried out research in the form of pasture improvement trials to determine the methods of grass propagation best suited to Niue conditions, however trials were incomplete when the work was abandoned earlier than expected.

7. RESEARCH AND DEVELOPMENT ORGANIZATIONS AND PERSONNEL

The Department of Agriculture, Forestry, and Fisheries (DAFF) has been doing research in pasture development in Niue. The section particularly involved in pasture research is the Crop Research Division and the following staff members are involved:-

Head of Section

Mr. Ernest Nemaia, Senior Crop Research Officer

Mr. New Testament Aue, Crop Research Trainee

Mr. Tuki Matagiaga, Crop Researcher

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