Country Pasture/Forage Resource Profiles

FEDERATED STATES OF MICRONESIA

by
Eroarome Martin Aregheore

CONTENTS

1. INTRODUCTION

The Federated States of Micronesia (FSM) which comprises four states, namely, Pohnpei, Chuuk, Kosrae and Yap was created from the former US Trust Territory of the Pacific Islands. The country lies approximately between 135^0 and 166^0 E and between the equator and 13^0 N. The total land area of is only 4 840 km^2. scattered over hundreds of thousands of sq. km of ocean and distributed among hundreds of islands and islets (see Figure 1). FSM includes the largest and most diverse part of Micronesia. The population tends naturally to be concentrated on the larger, high islands, though some quite small islands still support relatively large populations. The reported population of FSM in 2001 was 118 000 (Chuuk, 49%, Pohnpei, 34%, Yap 10% and Kosrea 7%) (Crocombe, 2001), although according to the World Factbook it has declined since,with a July 2008 estimate of 107 665 and a 2008 estimated growth rate of -0.191%. SPC (2008) estimates the mid-year 2008 population at 110 443, a mid-year projection for 2010 of 111 360 and an estimated growth rate of 0.4% in the 2008–2010 period.

Figure 1. Map of the Federated States of Micronesia
[Source: World Factbook]

The Island or state of Pohnpei is at 6^{0}54 N and 158^{0}14' E in the Caroline Islands group and is of volcanic origin and about five million years old. Rainfall is high and well distributed with an average of 4 820 mm and 300 rainy days per year (Lambert, 1982). At higher interior elevations, rainfall is estimated to reach 7 500 mm and the temperature averages 27 °C year round and humidity is high.

The island or state of Yap is the westernmost state, consisting of the high island of Yap proper and numerous but smaller islands. All these Islands together are called Yap islands. Yap lies about 725 km southwest of Guam and about 1 850 km east-southeast of Manila in the Philippines. A fringing reef system about 30 km long and about 13 km wide at its widest point encircles this close cluster of high islands that has a combined land area of about 120 km^2. (Young-Uhk, 1999)

Yap has a mean temperature of 24–30 ^{0}C with an average monthly temperature of 27 ^{0}C. Lying near the inter-tropical convergence zone the island's rainfall pattern is irregular. Yap is known as "the land of grass skirts and stone money". Agriculture is of subsistence type and the main crops are yam, banana, taro, coconut, citrus and cassava, *Colocasia* and *Xanthosoma*. The present vegetation of Yap is mainly coconut trees (*Cocos nucifera*),Pandanustrees (*Calophyllum* spp.), breadfruit (*Artocarpus atilis*) and small shrubs. Over the years agroforestry has remained the dominant system of food production (Young-Uhk, 1999).

The state or islands of Chuuk are in the central Caroline Islands of the west Pacific. The state consists of 15 island groups with a total land area of 188 sq. km scattered over an ocean area some 480 km by 960 km. The islands are surrounded by a barrier reef that is roughly circular in shape and is about 63 km. across. Chuuk proper is a complex group composed of 14 mountainous islands of volcanic origin, with a combined area of 72 km^2, surrounded by a great coral ring which forms a lagoon of over 2000 km^2. The outer islands of the state are all low islands or atoll. Most people live in small villages scattered

Table 1. Federated States of Micronesia statistics of livestock numbers beef production, milk, beef and veal and other meat imports for the period of 1997–2007

Item	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Cattle (head)	(13 900)*	(13 900)	(13 900)	(13 900)	75*** (13 900)	(13 900)	(13 900)	(13 900)	(13 900)	(13 900)	(14 000)
Buffalo (head)	(130)	(130)	(130)	(130)	20*** (130)	(130)	(130)	(130)	(130)	(130)	(140)
Goat (head)	(4 000)	(4 000)	(4 000)	(4 000)	177*** (4 000)	(4 000)	(4 000)	(4 000)	(4 000)	(4 000)	(4 100)
Pigs (head)	(32 000)	(32 000)	(32 000)	(32 000)	(32 000)	(32 000)	(32 000)	(32 000)	(32 000)	(32 000)	(33 000)
Beef prod. (mt)	(245)	(245)	(245)	(245)	(245)	(245)	(245)	(245)	(245)	(245)**	(260)
Cattle imports (head)	7	7	n.r	n.r	n.r	n.r	n.r	n.r	n.r.	n.r	n.r
Cow milk fresh imports (mt)	460	860	930	640	560	860	530	500	260 (+ 320 mt dried whole milk)	n.r	n.r
Beef and veal imports (mt)	30	450****	450****	30	40	290	130	770	1,770 (+)	n.r	n.r

n.r , no record; No data for 2008

Source: FAOstat (Numbers in brackets are questionable)

** SPC unpublished data for 1996 show cattle numbers of only 300 head*

*** Total meat production in 2006 was 1268 mt and in 2007 1299 mt (beef, chicken, goat and pig)*

**** Data provided by Engly Ioanis (FSM), College of Micronesia, Pohnpei, through Peter Saville (SPC).*

Break down by state:

	Cattle	*Buffalo*	*Goats*
Chuuk	*20*	*10*	*150*
Pohnpei	*50*	*10*	*20*
Kosrae	-	-	-
Yap	*5*	*0*	*7*

***** Total value of red meat imports 1998 - US$ 5.4 M, 1999 - US$ 4.8 M*

(FSM Statistics Office)

(+) In 2005 FSM also imported 11,580 mt of chicken meat, 7 960 mt of pork/pig meat and 170 mt of turkey meat

along the shores of all the green islands – so-called because there is a natural cover of dense tropical vegetation maintained by the high rainfall - that are in an area about 48 km by 19 km. Subsistence farming and copra production are the main agricultural enterprises. The main subsistence crops are banana, breadfruit, coconuts and taro.

The state or island of Kosrae consists of one large island and is the most easterly state in the Federated States of Micronesia. It is one of the most beautiful islands in the Pacific. It has an area of 109.6 km^2 and is mountainous and broken in the interior, but possesses four good harbours. It is forest clad, well-watered and is so fertile that almost any tropical product can be grown there. It has a population of 8 260 (Crocombe, 2001, Douglas and Douglas, 1994). Land on many coral islets is sparse and generally infertile. Only coconuts and pandanus will grow without considerable efforts, while land on high volcanic islands, though fertile land is often steep and inaccessible. Agricultural productivity therefore is rather low, although in traditional times subsistence agriculture was the economic basis of society (Douglas and Douglas, 1989).

The population of ruminant livestock is scattered amongst the different states of Micronesia. Within each of the states, the cattle and goat population is however small. Table 1 presents data on livestock population and import of meat and milk products. Generally the country relies heavily on the importation of meat and milk products to meet local demand. FAOSTAT shows much higher numbers than those obtained from FSM or SPC. As the FAOSTAT data are probably too high the numbers are shown in brackets.

2. CLIMATE AND AGRO-ECOLOGICAL ZONES

FSM has a tropical maritime setting and diurnal variations in temperature are greater than between seasons. Most islands have a marked dry trade wind season from November to May and a wet variable season from June to October. Constant high temperatures and high humidity with very high average rainfall characterize the wet tropical maritime. Typical daytime maximal temperatures are near 30 ^{0}C with minimum around 24 ^{0}C. Generally, there are variations between one island and another in climate and agro-ecological zones (Asher Moses, personal communication). Below is a brief on Pohnpei, Chuuk, Yap and Kosrae. In general, geography is extremely varied, ranging from isolated reefs and atolls barely above sea level to dramatic peaks of several hundred metres on the high islands of Pohnpei and Kosrae.

In the island of Pohnpei the climate is characterised by high rainfalls and high temperature. The average annual rainfall is 482 cm and the average annual temperature is 27 ^{0}C. The rainfall is fairly evenly distributed throughout the year, although the average January to February is about 30% less than the annual monthly average. The rainfall in the higher elevations is estimated to be as high as 750 cm annually in the mountainous interior areas. Here the average monthly temperatures do not vary from the annual average by more than 1 degree, and the difference between the average minimum and the average maximum temperatures is less than 8 degrees throughout the year. Temperatures are slightly lower at the higher elevations. Humidity is very high throughout the year (NOAA, 1987).

Pohnpei Island is typically volcanic, with a majority of the land area characterized as steep and mountainous. Vegetation is mainly upland forest (55.5%) mostly in the interior. The coastal areas and lower slopes are characterised by agroforest (33.4%) and secondary vegetation (5.2%). Agroforestry has been expanding rapidly in the last decades, replacing forest and secondary vegetation. A barrier reef and a lagoon surround the island, with extensive mangrove forest development around most of the shoreline.

In Chuuk, the climate is chiefly influenced from November to June by the north-easterly trade winds. By about April, the trade winds begin to diminish in strength, and by July they give way to the lighter and more variable winds of the doldrums. Between July and November the islands are frequently under the influence of the inter-tropical convergence zone. This is also the season when moist southerly winds and tropical disturbances are most frequent. The humidity at this time is often oppressively high. Rainfall averages about 365 cm a year. The most pleasant time of the year is the relatively dry period from January to March when monthly averages are less than 21 cm and February is the driest month with an average of 15.7 cm. Rainfall varies widely from year to year in amount and in seasonal distribution.

Annual totals have been as low as 300 cm and as high as 450 cm. Even in the drier season of January to March, monthly rainfall has been as much as 60 cm in some years, however, it has been less than 3 cm. Temperature is relatively uniform throughout the year varying 10 °C from the averages for the warmest and coolest months.

In Yap, the main annual rainfall is 3 028 mm. As a high island, Yap provides for the collection of rainfall and the flow of water from uplands to lowlands and then into the sea. This has resulted in a series of natural habitat zones where rainfall is buffered and sediments and nutrients carried with freshwater runoff are filtered out into a biotic communities successively less tolerant of the situation (Falanruw, et al 1987; Falanruw, 1993; Liyagel, 1993). The climatic conditions present classical problems of how to use tropical soils without exposing them to erosion and nutrient depletion.

Kosrae, is a high island and its climate and agro -ecological zones are similar to those of Pohnpei.

3. SOILS AND TOPOGRAPHY

Soils can be classified into two major groups with slight variations between one island and another (Laird, 1983a,b). Under the two groups are various sub-groups.

A. **Soils in coastal mangrove swamps, on coastal strands and on bottom-lands:** The soils in this group can be both shallow and very deep and are somewhat poorly drained. They formed from inorganic deposits and coral sand. This group is used for the production of wood, coconuts and wetland taro and for urban development. The native vegetation is mainly mangrove forest, atoll strand forest and water tolerant grasses. Under this group are the following:

- Shallow and very deep, very poorly drained, level and nearly level soils in coastal mangrove swamps. This type of soil is flooded daily with salt water during high tide. Also they are shallow and very poorly drained. They formed in a mixture of organic deposits and coral sand. The surface layer is peaty and sandy. The vegetation is mainly mangrove forest and used for mangrove wood production.
- Very deep, somewhat poorly drained, level and nearly level soils and urban land on coastal strands. These soils are very deep and somewhat poorly drained. They are formed in water and wind deposited sand derived dominantly from coral. The soils are sandy throughout. This type of soil is used for coconut production.
- Very deep, poorly drained, level and nearly level soils on bottom lands. The soils are on bottom lands and are very deep and very poorly drained. They are formed in organic deposits as well. The soils are mucky and peaty throughout. The vegetation on this type of soil is mainly tall water tolerant grass. This type of soil is used for taro production and it has few limitations for this use.

B. Soils on uplands: The soils in this group are shallow, moderately deep, and very deep and are well drained. They formed in residuum and colluvium derived dominantly from basic igneous rock. This group is used for subsistence farming. Under this group there are the following soil sub-groups:

- Very deep, well drained, sloping to extremely steep soils on uplands. These soils are very deep and well drained. They are also loamy and very stony throughout. The soil in this group is suitable for subsistence tree cropping.
- Rock outcrops, shallow and moderately deep, well drained nearly level to moderately slopy soils on uplands. This consists of areas of exposed volcanic rock on ridge tops and nearly vertical rock cliffs. The soils here are good for subsistence farming, woodland and wildlife habitat.

Soils in FSM vary widely in their potential for major land uses. In most of the islands in the Federated States of Micronesia, at least 30% of available land is used for subsistence tree crops, mainly bananas, breadfruit and coconuts.

The soils in Pohnpei generally have a clay-rich texture since they are derived from volcanic bedrock in a warm humid climate. However, on the steeper, upland hill slopes, soils can be quite rocky and in contrast, peat soils may form in the lowland swamps. The cohesion given the soil by their clay minerals

tends to decrease their erodibility by overland surface water flow. The fertility of the upland soils is normally greater than in the lowlands (McKean and Baisyet, 1994; Laird, 1983a).

Soils in areas under agroforestry are characterized by Typic Acrorthoxes in the lowlands and Typic Dystropepts on mountain slopes, with a few small areas of Typic Humitropets (Laird, 1983a,b). Soils in the upland mountainous areas are generally deep and are limited by steep slopes and stoniness. These areas are nearly level or gently well drained. Low fertility and wetness are limitations. The bottomland soils are generally poorly drained and are limited by wetness.

4. RUMINANT LIVESTOCK PRODUCTION SYSTEMS

Small and large ruminant livestock (cattle, buffalo and goats) are, found in varying numbers in the different islands that constitute the Federated States of Micronesia (refer to Table 1). Breeds of cattle are Brahman; Brahman crosses and other mixtures. These animals were imported into the territory some years ago. The Brahman breed was selected for FSM because of its short hair and tick resistance (Sproat, 1954). The size of the animal and rapid growth rate helped to naturally up-grade local beef quality and quantity. The production systems adopted vary from one island to another depending on the land area and the number of available animals. Data for numbers and production vary with source and FAOSTAT data (except for beef and veal and other meat and milk imports) appear to be too high with numbers carried through unchanged from 1995 to 2006.

However two production systems are in place – government/commercial and subsistence or smallholder. In either of the production systems the animals are grazed under coconut trees to control weeds and for easy collection of nuts.

(1) Government/commercial farmers own ranches and coconut plantations where most animals were kept to produce stock for sale to retailers, restaurants and hotels, etc. This sector was highly organized in the production of cattle and goats for the populace but has declined as livestock numbers have decreased in recent years.

(2) The subsistence/smallholder livestock farmers keep most of the cattle and goats found in the Federated States of Micronesia. They raise their animals in pens, backyards and often on free range or tethered. Under this sector, animals are raised for family consumption and for festive occasions such as weddings, traditional celebrations, source of immediate income, etc.

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

1. Most people are not used to rearing ruminants.
2. The land tenure system in FSM militates against the development of pasture. Limited land is available
3. The soil and terrain of most islands are not suitable for large-scale pasture production.
4. Most farmers are more interested in the free-range system of production.

6. THE PASTURE RESOURCE

Right from the time of the previous foreign administrations, several grass and legume varieties were introduced to supplement indigenous forage feeds for livestock. The availability of grasses and legumes varies from one island to another.

6.1 Improved pasture grass varieties

There are number of predominating pasture grass varieties found in the Federated States of Micronesia. These are:

Carpet grass (*Axonopus compressus*). This is a low growing, stoloniferous perennial grass. It is well adapted to a wide range of soils. It spreads both by runners and by seeds and is well adapted to wet and shady conditions. It is generally low yielding but grows well together with the legumes.

Elephant or Napier grass (*Pennisetum purpureum*). Is a tall deep-rooted perennial grass. It is widely grown in the tropics as a forage and pasture plant. The grass is more suitable forcutting as fodder than for grazing, however under rotational grazing systems a satisfactory stand can be maintained for many years. Elephant grass is normally established vegetatively from stem cuttings planted similarly to sugar cane in rows of 60–90 cm apart. The yield of green forage depends upon soil fertility and on how much fertilizer is applied. Compared to other tropical pasture grasses, it has a high yield (120 tonnes per acre are not uncommon). The young leafy grass has low dry matter content (10–15%)

Guinea grass (*Panicum maximum*). Guinea is an erect perennial grass. It can grow up to 2 m in height if not grazed. It is a tufted grass that grows from the rootstock. There are different varieties of guinea grass that have slightly different characteristics. Examples are tall guinea (a very tall and robust variety that is well accepted by cattle); creeping guinea (a grass very well adapted for coconut plantations) and common guinea (does not grow as high as tall guinea, but tall enough to interfere with coconut harvesting. Guinea grass may be propagated by seed or parts of the vegetative rootstock or by subdividing the plant into smaller parts followed by planting the divisions into holes. Seed propagation can be unreliable due to poor seed viability. Creeping guinea grass is very shade tolerant and therefore suitable under plantations. Guinea grass can also be used in open pastures where it can be combined with legumes in such a way that the legume can grow in the open spaces between bunches to prevent weed growth as well as fixing nitrogen. It is a grass that cannot stand waterlogged areas; therefore a well drained soil is required for its growth.

Para grass (*Brachiaria mutica*). Commonly used as a pasture grass in rotational grazing and can also be cut for green fodder or used for hay. Para is a perennial grass that is widely distributed in the tropics and sub-tropics especially in areas with heavy rainfall. It is not a suitable grass species during the dry season because of it high water requirement. It is a grass that is well suited to very wet even-logged soils however; it still maintains a high dry matter content. It can be cut at intervals of 4–6 weeks, and it compares well in quality with most tropical fodder crops. Para grass combines well with creeping tropical legumes such as Siratro (*Macroptilium atropurpureum*).

Signal grass (*Brachiaria decumbens*). This is a coarse, perennial grass with an erect, ascending stem up to 1 m high. The nodes are usually smooth but sometimes slightly hairy. It is propagated from stem cuttings and is an aggressive grass and easily smothers weeds and covers the ground rapidly. It can be used in grass/legume mixtures. It is shade tolerant, therefore it is a recommended pasture species under coconuts and it has proven to produce good quality forage palatable to cattle. It is well established on different soils but does require well-drained soil although it has been shown to be resilient against temporary flooding.

Other grass species found are *Paspalum conjugatum, Oplismensus compositus, Paspalum orbiculare, Ischaemum cordatum,* Bermuda *grass (Cynodon dactylon)* and *Cyrtococcum patens*. Of the grasses, *Axonopus compressus* is most widespread. Cattle do not like it, tending to graze on younger stems when other more palatable feeds are not available. Most of the grasses were introduced from Australia to FSM.

6.2 Improved legume varieties

Improved legume varieties found are *Centrosema* pubescens (Centro) *Desmodium uncinatum* (Silverleaf), *Desmodium incanum* and *Derris elliptica.* Other legumes are *Mimosa pudica, Desmodium triflorum* and

Cordyline terminals. Also there are fodder/shrubs such as *Leucaena leucoccephala, Gliricidia sepium* and *Erythrina* spp. used as supplements because of their high protein content.

Centrosema spp. are by far the most palatable and desirable because of their nitrogen fixing habit and creeping growth habit. Just like the grasses, most of the legumes were introduced from Australia and Hawaii.

The use for green fodder of the leaves of sweet potato *(Ipomoea batatas)*, Noni (*Morinda citrifolia)* and *Hibiscus tiliaceus* are not uncommon.

6.3 Weed control

- Manual removal of weeds
- Use of herbicides.
- The use of grazing animals especially under coconut plantations.

6.4 Recent initiatives in forage improvement

1. Introduction of improved grasses and legumes in relation to plantations and cattle that were centred mainly on the importation of nitrogen fixing legumes that are palatable and nutritive to animals.
2. Introduction of agroforestry into the agricultural production systems of the different islands (Raynor and Fownes, 1993; Young-Uhk, 1999).
3. Training of personnel in the field of livestock production at the Diploma and Degree levels.

7. RESEARCH AND DEVELOPMENT ORGANIZATIONS AND PERSONNEL

Head
Division of Agriculture,
Department of Resources and Development
Palikir, Pohnpei 96941
Federated States of Micronesia.

8. REFERENCES

Crocombe, R. (2001). The South Pacific Institute for Pacific Studies, The University of the South Pacific, Suva, Fiji. 790 p.

Douglas Norman and Douglas Ngaire, (1989) Federated States of Micronesia.: In Pacific Islands Yearbook. 16th Edition. Angus & Robertson Publishers in association with Nationwide News Pty Ltd, Auckland, New Zealand. Pp. 69–85.

Douglas Norman and Douglas Ngaire, (1994) Federated States of Micronesia.: In Pacific Islands Yearbook. 16th Edition. Angus & Robertson Publishers in association with Nationwide News Pty Ltd, Auckland, New Zealand. Pp. 129–157.

Falanruw, M.C. Cole, T. and Whitesell, C. (1987) Vegetation types on acid soils of Micronesia. In proceedings of the Third international Soil management Workshop on the Management and utilization of Acid soils in Oceania. Republic of Palau. Feb. 2-6, 1987, pp 235–245.

Falanruw, M.V.C. (1993) Micronesian agroforestry: Evidence from the past, Implications for the future. Proceedings of the workshop on Research methodologies and Applications for pacific Island Agroforestry, July 16–20, 1990, Kolonia, Pohnpei, Federated States of Micronesia. Pp. 37–41

Lambert, M. (1982) Federated States of Micronesia. In: An overview of some Pacific atolls. Regional Technical meeting on atoll cultivation, Papeete, Tahiti, French Polynesia, 14-19 April, 1980. Technical Paper No. 180, South Pacific Commission, Noumea, New Caledonia, February 1982. Pp 6–9.

Laird, W.E. (1983a) Soil survey of Ponape, Federated States of Micronesia. USDA Soil Conservation Service; 81 p w/maps.

Laird, W.E. (1983b) Soil survey of Truk, Federated States of Micronesia. USDA Soil Conservation Service; 65 p w/maps

Liyagel, P., (1993) Yapese Land Classification and use in relation to Agroforests. Proceedings of the workshop on Research methodologies and Applications for pacific Island Agroforestry, July 16-20, 1990, Kolonia, Pohnpei, Federated States of Micronesia. P. 59.

McKean, J. and Baisyet, P. (1994) Watershed management of the Islands of the South Pacific: Tonga, Cook Islands, Pohnpei (Federated States of Micronesia) Palau. USDA Forest Service. UNDP/FAO South Pacific Forestry Development Programme, RAS/92/361. Field Document No. 5 November 1994. Appendix 6. pp. 86–105.

NOAA (1987) National Oceanic and Atmospheric Administration. Local climatological data: annual summary with comparative data: Pohnpei, Eastern Caroline Islands, Pacific. NOAA, National Climatic Data Centre, Asheville, North Carolina, 5 p.

Raynor, B. and Fownes, J. (1993) An Indigenous Pacific Island Agroforestry System: Pohnpei Island. Proceedings of the Workshop on Research Methodologies and Applications for Pacific Island Agroforestry, July 16-20, 1990, Kolonia, Pohnpei, Federated States of Micronesia. Pp. 42–58.

SPC (2008). SPC releases latest Pacific population data.

Sproat, M.N. (1954) Cattle breeding in the trust territory. SPC Quarterly Bulletin, July, 1954, Pp 17 and 20.

Young-Uhk, S.G. (1999) Traditional cropping systems, Techniques and Knowledge in Yap Islands, Federated States of Micronesia. B.Agriculture Project, The University of the South Pacific, School of Agriculture, Alafua Campus, Apia, Samoa. 57 pp.

9. CONTACTS

This profile will be updated from time to time and was written by **Eroarome Martin Aregheore** while he was at:The University of the South Pacific, School of Agriculture, Alafua Campus, Apia, Samoa.

Present address/contact:
Eroarome Martin Aregheore, PhD
Marfel Consulting (Agricultural and Educational Services)
118-7341, 19th Avenue
Burnaby, BC, Canada, V3N1E3
Tel: 604 395 5428
778 991 2295 (Cell)
Email: aregheore_m@yahoo.com

[The profile was lightly edited by J.M Suttie and S.G. Reynolds in May 2002 and slightly modified in October 2006, June 2008 and January 2009 by S.G. Reynolds.]