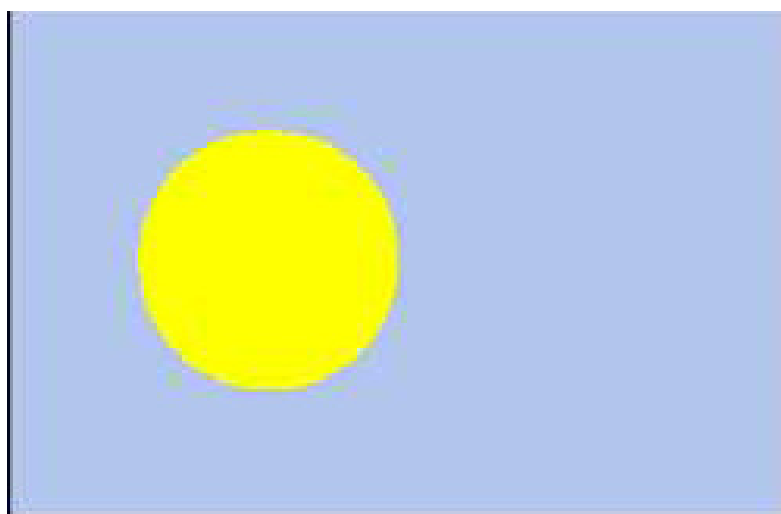


Country Pasture/Forage Resource Profiles

PALAU



by

Eroarome Martin Aregheore



The designations employed and the presentation of material in this information product do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations (FAO) concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. The mention of specific companies or products of manufacturers, whether or not these have been patented, does not imply that these have been endorsed or recommended by FAO in preference to others of a similar nature that are not mentioned.

The views expressed in this information product are those of the author(s) and do not necessarily reflect the views of FAO.

All rights reserved. FAO encourages the reproduction and dissemination of material in this information product. Non-commercial uses will be authorized free of charge, upon request. Reproduction for resale or other commercial purposes, including educational purposes, may incur fees. Applications for permission to reproduce or disseminate FAO copyright materials, and all queries concerning rights and licences, should be addressed by e-mail to copyright@fao.org or to the Chief, Publishing Policy and Support Branch, Office of Knowledge Exchange, Research and Extension, FAO, Viale delle Terme di Caracalla, 00153 Rome, Italy.

CONTENTS

1. INTRODUCTION	5
2. CLIMATE AND AGRO-ECOLOGICAL ZONES	5
3. SOILS AND TOPOGRAPHY	6
4. RUMINANT LIVESTOCK PRODUCTION SYSTEMS	6
5. CONSTRAINTS TO DEVELOPMENT OF PASTURE-BASED LIVESTOCK PRODUCTION SYSTEMS	7
6. THE PASTURE RESOURCE	7
6.1 Local/natural pasture	7
6.2 Improved/established pasture grass varieties	8
6.3 Improved/established legume varieties	8
6.4 Weed control	8
6.5 Recent initiatives in forage improvement	8
7. RESEARCH AND DEVELOPMENT ORGANIZATIONS AND PERSONNEL	9
8. REFERENCES	9
9. CONTACTS	10

1. INTRODUCTION

The Republic of Palau is a chain of islands located between 5° 53' and 8° 12' north and 134° 07' and 134° 39' east. There are about 350 islands which vary in size from small islets to Babelthiap, which is one of the largest islands in the western Pacific Ocean. The Republic of Palau is composed of an island group known as the Palau Islands to the North and the four small, isolated coral islands of Sonsorol, Merir, Pulo Anna and Tobi and the adjacent atoll of Helen reef to the southwest (van der Brug, 1984) – see Figure 1. Palau forms the Western end of the Caroline Island chain. It has a northeast-southwest extent of about 640 km and the town of Koror on Koror Island is the provisional Capital.

All the islands are enclosed within a 104 km-long reef except for Angaur in the south and several small atolls in the north (McKean and Baisyet, 1994). Palau had a population of between 19 000 –20 000 inhabitants in 2001 (Crocombe, 2001); according to SPC the mid 2000 population was 19 100 and according to the last census in 2005 the population was 19 907. Latest SPC estimates (SPC, 2008) for mid-2008 are 20 279 and 20 519 in mid-2010 (with a population growth rate 2008–2010 of 0.6%) while according to the World Factbook the July 2008 estimate is 21 093 with a growth rate of 1.157%. The main populated islands in Palau are Babelthiap, Koror, Malakal, Arakebesan and Peleliu, all of which lie within a single barrier reef enclosing a 1 267 km² lagoon on the west side. Babelthiap is the largest island while Koror Island is the highest populated centre, with the capital city Koror.

Traditional crops in Palau have included true taro (*Colocasia esculenta*), giant taro (*Alocasia macrorrhiza*), cassava (*Manihot esculenta*), sweet potato (*Ipomoea batatas*), true yam (*Dioscorea esculenta*), bitter yam (*Dioscorea bulbifera*), Pawpaw (*Carica papaya*), betel nut (*Areca catechu*), banana (*Musa* spp.) and coconut (*Cocos nucifera*). Also, recent introductions to Palauan agriculture are Chinese cabbage (*Brassica chinesis*), eggplant (*Solanum melongena*), squash (*Cucurbita maxima*), and watermelon (*Cucumis melo*), (Wilson, *et al.* 1996). According to a report by Nakamoto *et al.* (1996), although local vegetable and melon production is increasing (particularly to supply the fishing boats), Palau relies increasingly on food imports with estimates for 2000 import levels being 1.1 M lbs of chicken and 3.3 M lbs of rice. A 2002 Bank of Hawaii report provides some general information on the status of agriculture in Palau and a more detailed version suggests that while there is potential for agricultural growth the likelihood of this happening is slight because “it costs less to import foods and fibre than to produce them in Palau”. A USDA Natural Resources Conservation Service report mentions the “typical crops include taro, peppers, cassava, pineapple, sweet potato, sugar cane, yams, okra, and tree crops include coconuts, bananas, citrus, papaya, and mango. There are also many small-scale livestock operations raising pigs and chickens”. Although there is no mention of ruminants, sales of small amounts of local beef are mentioned in several reports.

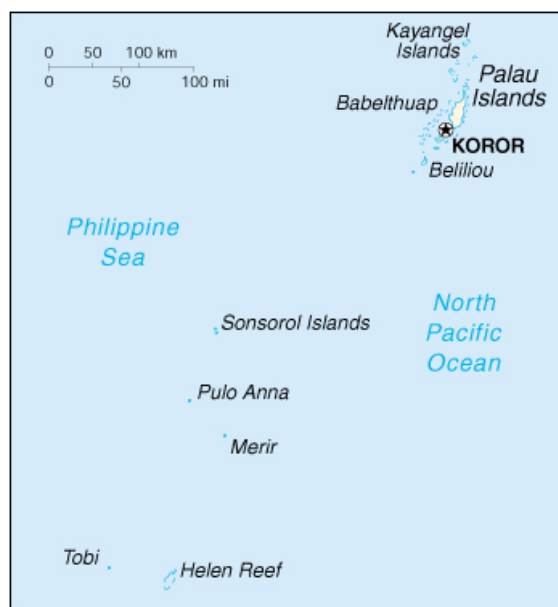


Figure 1. Map of Palau

Source: *The World Factbook*

2. CLIMATE AND AGRO-ECOLOGICAL ZONES

Palau is tropical and the climate shows little variation with a mean annual temperature of 27 °C on Koror and rainfall of 3 800 mm a year and 3 302 mm on Angaur. Rainfall is well distributed throughout the year, with a thirty-year average of 3 630 mm. There is a drier period from January to April when the

average monthly rainfall is 229 mm, although at times it can be as low as 147 mm. The months of June–August are usually slightly wetter and overcast. During the drier season water availability can sometimes be a limiting factor for the growth of pasture, especially *Ischaemum*, due to the free draining soils and low organic matter levels under grasses. However, water availability is not otherwise considered a limiting factor for plant growth.

About 75% of Palau is covered with a native tropical forest, much of it on the inhabited rock islands. The remaining 25% of the land area is agroforest, savannah grasslands, marshes, and urban areas. At least some of the grasslands were created by conversion from forests by repeated burning over many centuries (McKean and Baisyet, 1994). The vegetation in the volcanic islands of Palau varies from the mangrove swamps of the coast, with trees often from 10–16 m high; to the savannah type grasslands of the near interior which support palms and pandanus, and the densely forested valleys further inland. In brief, Palau is fertile with mangrove swamps along the coast backed by savanna and coconut and Pandanus palms, rising to rain forest in the hills. The outlying coral islands are mostly wooded and support mostly coconut palms.

3. SOILS AND TOPOGRAPHY

The soils of Palau are mostly ancient and of volcanic origin. They have been heavily leached by the high rainfall over a long period and are generally deficient in phosphorous, nitrogen and calcium. Potassium, manganese, iron and aluminium levels are mostly high. Most soils in Palau are well drained upland latosols of silty clay loams. Based on the survey, *Military Geology of Palau Islands* (US Army Corps of Engineers, 1956), the major soil types in Palau are classified as:

- (a) Palau Association (over hard volcanic rock);
- (b) Ngardok Association (over soft volcanic rock);
- (c) Ngatpang silty clay loam (over bedded clay);
- (d) Babeldaob Association (containing bauxite); and
- (d) Tabecheding Association (over bedded clays).

The more important soil types where pastures could be grown for cattle production are the Palau Association. This is where most of the extensive upland grasslands occur and the smaller patches of alluvial soils that are usually found around existing settlements.

Generally, soils on upper slopes and ridges are heavily leached and covered with concretions of Al- and Fe- oxides. Such soils support poorer vegetation with shrubs, ferns and sedges. At the base of slopes, the soils are richer and more moist (occasionally swampy) supporting dense stands of palatable grasses. The acid nature of the soil (mostly below pH 5) which results in low phosphorus availability suggests that the application of coral sand is beneficial to plant growth (Mayer, 1982).

Arekabesan and Malakal islands are of volcanic origin while Babelthuap and Koror are partly elevated limestone and partly volcanic. Auluptagel, Ngargol, Urukthapel, Peleliu and Angaura are of raised coral limestone. Of the Palau islands group, Peleliu alone is flat.

4. RUMINANT LIVESTOCK PRODUCTION SYSTEMS

In the past buffalo, cattle (beef) and goats have been the major ruminants in Palau livestock agriculture, but numbers now are very limited. There is little statistical data on present livestock production in Palau. Beef cattle production seems to be more organized and the animals are raised on either improved or natural pastures depending on the area of Palau. The prevalent cattle breed is the Brahman (Wilson, *et al.*, 1996). Three ruminant livestock production systems have existed in Palau, but at present the most predominant is the subsistence system.

During the Colonial era of Japanese rule of Palau [1914–1943], large commercial (ranch) farms were operated by the Japanese Training Centre (OISCA) and wealthy individuals. The farms under this

category raised many cattle herds at a time. For example, the OISCA had feedlots and the financial capability for large-scale operation, in terms of number of animals, technical know-how, management skills, disease control and sales of their animals.

The next category of ruminant livestock operator is the Government Department of Agriculture (Palau Community Action Agency, PCAA) that serves as a research station, providing training and extension services and supplying animals to organizations or individuals with interests in livestock (ruminant and monogastric) production. The smallholder or subsistence livestock farmers are the third group and they raise small numbers of animals for family use or to meet traditional social obligations. These animals are kept as a sideline operation to crops. The animals in most cases are tethered or grazed on natural pasture along road embankments. These farmers usually raise beef cattle and goats under the same management and production system. Numbers have declined (although few data are available) and at present very few cattle are found in Palau (Bamman, Heiko, 2000, personal communication). In 1984 there were 82 cattle, 52 goats, 1 343 pigs and 9 500 poultry (Palau report). In the 1989 Agricultural Census for Palau only pigs and chickens were recorded and the author was unable to obtain results from the 1994 Census. However, sales of local beef are mentioned in reports from 1995–97 and also in the Statistical Yearbook 2001 for Palau (Robin De Meo, personal communication). A report on “The animal health status of Palau” (Saville, 1999) mentions livestock numbers as: cattle – 23; pigs – 862; poultry – 20 702; horses – 3; buffalo – 1 and goats – 32.

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

There are a number of factors that limit pasture based livestock production in Palau. Physical, climatic and social factors account for most of the constraints encountered. These include:-

- (1) Smallholder farmers lack enough farmland for the development of pasture;
- (2) Most farmers are unwilling to plant a crop that has a long growth period. To them planting and harvesting of vegetables in a short period of time provides a cash flow for paying workers and buying supplies;
- (3) Farmers are unwilling to attempt something that requires more effort and cost unless there is an incentive to do so;
- (4) Problems of water availability during the drier season can sometimes be a limiting factor for the growth of pasture especially due to the free draining soils and low organic matter levels under grasses;
- (5) The smallholder farmers do not have the financial means to lease farmland for pasture establishment;
- (6) Imported meat is cheaper than locally produced meat;
- (7) The Animal Industry Division of the DAMR (Division of Agriculture and Mineral Resources) lacks trained staff and the institutional ability to support and advise farmers who might be interested in pasture development.

6. THE PASTURE RESOURCE

Rainfall is well distributed throughout the year in Palau, therefore pasture resource is available all year round for ruminant livestock production. The available pasture resources can be classified as local/natural and improved/established (Mayer, 1982).

6.1 Local/natural pasture

The distribution of various species present in natural grasslands or of potential value to ruminant feeding consists of *Paspalum orbiculare*; *Pennisetum purpureum*; *Pennisetum polystachyum*; *Pueraria lobata*; *Saccharum spontaneum* and *Vigna hosei*.

Paspalum orbiculare: Coarse tufted grass; common in poorer *Ischaemum* grasslands especially with increases in *Rhynchospora rubra* or *R. inundata* (Rabbit foot grass) at the expense of *Ischaemum* with overgrazing, and is relatively unpalatable.

Pennisetum purpureum: Tall spreading grass, local grass in coral-enriched areas with adequate moisture, spreads well once it establishes, and is very palatable.

Pennisetum polystachium: Also a tall spreading grass, very local grass in some coral-enriched areas, more woody than *P. purpureum*.

Pueraria lobata: This is a trailing semi-woody vine legume. It is widespread in some *Ischaemum*/*Rhynchospora* grassland on upper slopes. It spreads rapidly, seems to be encouraged by grazing possibly due to opening of the grass canopy, shows a preference for cow manure as source of nutrients for growth and it is palatable.

Saccharum spontaneum: This is a tall semi-woody grass that is locally common in richer spots of *Ischaemum*/*Rhynchospora* grasslands and the younger growth is palatable.

Vigna hosei: This is a creeping legume that is very common on alluvial soil under *Ischaemum*. It survives well under heavy grazing and it is very palatable.

6.2. Improved/established pasture grass varieties

Improved/established pasture species were introduced as part of an attempt to increase the carrying capacity and to determine the feasibility of such an intensive approach. The species used consists of the following grass species *Brachiaria decumbens* (Signal grass); *Brachiaria mutica* (Para grass); *Brachiaria ruziziensis* (Congo grass); *Melinis minutiflora* (molasses grass); *Panicum maximum*, cvs Riverside, Coloniao, Hamil (Guinea grass); *Paspalum plicatum*; *Setaria sphacelata* cv Kazungula, Nandi and *Urochloa mozambicensis*.

6.3 Improved/established legume varieties

The legumes species available are *Calopogonium mucunoides* (*Calopo*); *Centrosema pubescens* (*Centro*); *Desmodium heterocarpon*; *Dolichos axillaris* (Archer dolichos); *Glycine wightii* cv Cooper; *Leucaena leucocephala* cv Peru and Cunningham; *Macroptilium atropurpureum* (*Sirato*) and *Stylosanthes guianensis* cv Cook, Endeavour, Schofield (*Stylo*).

Most animals graze fallow land and in most cases serve a dual purpose as weed controllers especially under coconut trees (for more information on the use of livestock as weed controllers under coconuts see Reynolds, 1995).

6.4 Weed control

Sedges are the major weeds of economic importance found in Palau. *Fimbristylis dichotoma*, *F. cymosa* are locally common in damper batiki (*Ischaemum*) grassland that grows mostly on alluvial soil. *Cyperus* spp are found in similar places and also on lower slopes of *Ischaemum* hill grassland along with *Scleria* spp. On poor leached upper hill slopes, *Rhynchospora rubra* is often dominant, while the proportion of *Ischaemum* increases down the slope. *Scleria* spp mostly replace *Rhynchospora* in the damper hollows.

Weed control is achieved by slashing of fern and small shrubs with rotary slashers (one small, one large) pulled by the tractor. Manual and chemical control measures are also used.

6.5 Recent initiatives in forage improvement

- (1) Introduction of grass/legume mixtures to farmers as a means of improving the quality of feed on offer;
- (2) The introduction and the planting of improved legume species. This is achieved by over-sowing of the improved legumes in order to produce enough seeds for distribution to farmers .
- (3) The introduction of agroforestry systems into ruminant livestock production and management i.e.

where available ruminant livestock are used to graze the undergrowth of forestry and coconut plantations.

- (4) Adoption of improved grazing procedures such as rotational and strip grazing. This system aims at making more efficient use of available pasture and reducing problems of overgrazing.
- (5) Constant sampling of soils and available pasture for laboratory analyses to detect deficient nutrients. Such experiments are aimed to correct for deficient nutrients (macro and micro) through the application of fertilizer to the soils.
- (6) Growing of supplementary feeds to supplement animals during adverse situations.
- (7) Farmers are now trained on a regular basis on how to establish and manage pastures.

7. RESEARCH AND DEVELOPMENT ORGANIZATIONS AND PERSONNEL

- (1) Department of Agriculture and Mineral Resources
Animal Industry Branch
Bureau of Natural Resources and Development,
Republic of Palau.
- (2) Constantino Remeliik,
Livestock Production Office
Animal Industry Branch
Bureau of Natural Resources and Development,
Republic of Palau.

8. REFERENCES

- Crocombe, R. (2001). Institute of Pacific Studies, The University of the South Pacific, Suva, Fiji. 790 pp.
- Mayer, L. (1982) FAO/UNDP Livestock Development Project. Koror, Republic of Palau (November 1979-1982). End of Assignment Report. pp. 1-55.
- 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.
- Nakamoto, S.T., Rowley, H.K and D.A. Martin. (1996) Evaluation of Agricultural Statistics for ADAP. A publication of the Land Grant Institutions of the Pacific, 24 p.
- Reynolds, S.G. (1995). Pasture-Cattle-Coconut Systems. FAO/RAPA publication 1995/7, 668 p.
- Saville, P. (1999) The animal health status of Palau. SPC Noumea, New Caledonia. 19 p.
- SPC (2008). SPC releases latest Pacific population data.
- van der Brug, O. (1984) Water resources of the Palau Islands: U.S.G.S., Water Resources Investigations Report 83-4140.
- Wilson, T., Francisco, H., Brel, M., Remarii, J., Regulbai, K., Remeliik, C. and Ngiralemu M.G. (1996) Agriculture, Livestock and Forestry Five-Year Action Plan (1997-2001). Presented to the Republic of Palau Bureau of Natural Resources and Development, 1-94 p.
- US Army Corps of Engineers, (1956) *Military Geology of Palau Islands*

Websites

Palau

Palau Economic Report [Asian Development Bank, 2006]

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 revised by Reynolds in May 2006 and January 2009.]