INFORMATION CIRCULAR

Date	Classification	Serial No.
April 1974	Livestock Production	58

SOME ASPECTS OF PASTURE RESEARCH AND DEVELOPMENT

by

Peter Bewg
Animal Production Officer
South Pacific Commission

INTRODUCTION

Participants at regional agricultural meetings often express a wish for more frequent interchanges of information between the various countries and territories of the region on agricultural matters. The need for more information on pasture research and development is particularly marked.

The Commission's Animal Production Officer recently made short visits to Papua New Guinea (Markham Valley and Chimbu areas) and to north-eastern tropical Queensland (Cairns and Townsville). The purpose of these visits was to see what is being done practically and experimentally in pasture work, with a view to making the information available to South Pacific countries and to applying such knowledge as seems appropriate.

One of the striking features noticed on this tour was the relative lack of factual information on the productivity of pastures. There is an evident need for more information to be produced on the often overlooked purpose of pastures: liveweight gains.

PAPUA NEW GUINEA

I. Markham Valley

There are no records on properties exact enough to give indications of stocking rate or of animal output. Many "improved" pastures in the Markham Valley run out very quickly, and production from legumes is very low. Phosphorus and potassium improve production and help reduce weeds but are expensive and not generally used. Weeds are a serious menace to pastures in New Guinea.

Dry conditions

The dry belt around Port Moresby is particularly difficult: the soils are either dry, or swamp. Evaporation is greater than precipitation; this is made possible by the overflow of rivers fed by rainfall outside the area.

Green Panic (Panicum maximum var trichoglume), Biloela buffel (Cenchrus ciliaris var, biloela) and Nandi blue grass (Dichanthium caricosum) appear to be the best grasses for dry conditions but even so are not really suited to poor grazing conditions of management.

Wet conditions

Para grass (Brachiaria mutica), Guinea grass and Hamil grass (Panicum maximum vars. Guinea and Hamil) have emerged from trials as the most suitable grasses. Centro (Centrosema pubescens), Puero (Pueraria phaseoloides), Greenleaf desmodium (Desmodium intortum) and Silverleaf desmodium (D. uncinatum) are the favoured legumes.

Swamps

Para grass is the chosen grass where it is wet, although it will not grow in stagnant (non-moving) water. It may drown and die if submerged in a flood.

Alluvial flats

Originally, and often still, covered by rain forest, these are fertile areas. It costs $A47 to clear to the ploughing stage and another $A18 to plant Elephant grass (Pennisetum purpureum) and Centro (Centrosema pubescens). The established pasture is reported to have supported 1.9 beasts/ha for ten years.

II. Erap Research Station

Rainfall averages 1,300 mm. A pasture grazing comparison has begun. Treatments are:

(a) Hamil (Panicum maximum var. Hamil) and Buffel (Cenchrus ciliaris vars.) plus 112 kg N/ha (100 lb/ac).

(b) Hamil + buffel + legumes.

(c) Kunai grass (Imperata cylindrica) + legumes.

(d) Kunai grass.

There are no long-term results as yet, but daily liveweight gains have been observed of 0.60 kg on "improved" and 0.45 kg. on "native" pasture (Kunai). It has been calculated that proper cultivation ($A50), seed bed preparation, fertilisers ($A25) and seeds ($A25) could cost $A100 per acre for well-established "improved" pasture ($A250/ha).

The following comments were made:

"Pure grass pastures may be essential due to the high cost of P. (for legumes)."

"There are too many species of grass and legumes under discussion... we need to reduce the list to a workable length."

"There may be a need for a "pasture mix" to cover varying soil types and selective grazing."

III. Benabena Research Station

A grazing trial at different stocking rates has not shown any change in pasture. However, all liveweight gains were reported to be similar so that perhaps none of these rates approached a condition of stress. Stocking rates ranged from 0.25 to 0.60 steer equivalents per ha. In year 2, extra animals were added to each plot. Where grass is grazed short, wild pigs root it up and cause damage.

Liveweight gains quoted in relation to Beef Schemes administered from the Station are as follows:

(a) Setaria/Guinea pasture 0.65 kg/day (1.45 lb)

(b) Koronivia grass (Brachiaria dictyoneura) 0.35 kg/day (0.73 lb)

(c) Kunai (Imperata cylindrica) grazed at 1 beast/ha. A 10-month steer of 227 kg liveweight (500 lb) at age 30 months produces a 250 kg carcase (550 lb) equivalent to a 454 kg liveweight (1,000 lb). This represents a daily liveweight gain on Kunai of 0.36 kg (0.87 lb).

IV. Grasses

(a) Imperata cylindrica (Kunai)

This grass is satisfactory for grazing when young but is less useful or palatable as it matures. However, if it is heavily grazed to produce short young shoots the stand declines and weeds infest it. It "goes out" under heavy grazing. Burning can be used to maintain a short, young growth but this destroys the humus layer and any legumes which are present. It is not known how much the legume content increases production from Kunai. One manager thinks present stocking rates may be far too optimistic for the long run.

An Imperata/Themeda (Kangaroo grass) mixture stands reasonably heavy grazing, but above this rate it is invaded and replaced by Axonopus species (Carpet grass). The calculated stocking rate is between 0.25 and 0.50 beasts per ha and is usually at the higher rate. There is no evidence of advantage from rotational grazing and, in fact, if badly managed, it may result in some overgrazing.

Dry lowlands

On the dry lowlands Kunai is only seen as a short-term plant. It is hard to maintain, burning destroys any legumes and without burning it "goes out".

Wet lowlands

The main knowledge seems to be that Imperata will not last under grazing.

(b) Themeda australis (Kangaroo grass)

Where this occurs with Kunai it tends to disappear with grazing and to be replaced with Axonopus spp. The process is non-reversible. It is estimated that 0.6 beasts per ha (0.25 per ac) is the correct stocking rate: this is claimed to provide 0.56 kg of daily liveweight gain (0.87 lb), which allows turn-off of a finished beast in 3 years.

Drier areas

Themeda stands in drier areas will not tolerate grazing above 0.25 beasts per ha.

(c) Panicum maximum (vars) (Guinea, Hamil, Green Panic)

Guinea and Hamil are variable in performance, susceptible to different kinds of management and frequently invaded with weeds. It is a mistake to plant a small area of Guinea as it will be grazed out. It stands a better chance if a large area is established. Green Panic was grazed out when tried in the Ramu/Markham Valley. Guinea and Hamil were preferable although Guinea did not persist.

(d) Setaria spp. (Setarias)

A yield trial at Aiyura gave high Dry Matter results for Setaria, but three Setarias under grazing at unspecified rates and times resulted in disappearance of the legume content and deterioration of grass quality. There was no response to a dressing of 250 kg per ha (2 cwt/ac) of superphosphate. Liveweight gain was 0.45 kg daily (1 lb) in the first year and 0.32 kg (0.7 lb) in the second year.

The pasture was then reseeded and 560 kg per ha (5 cwt/ac) of superphosphate added. Liveweight gains went up to 0.68 kg (1.5 lb) per day. It is not known if it was the grass, the legume or the fertiliser which produced the improvement.

At Koroba there has been a deterioration of cattle grazing Nandi Setaria.

(e) Brachiaria mutica (Para)

Felled rain forest

Para grows well and smothers everything including regrowth. It can be grazed after 3 to 6 months of planting. Rate of hand planting is 0.05 ha (1/8 ac) per day.

Liveweight gain

A 10-months steer will produce a 250 kg (550 lb) carcase after 20 months, representing a daily liveweight gain of 0.42 kg (0.93 lb). Results are poorer in the second year and cutting trials suggest a shortage of nitrogen. An estimate was made of 0.40 kg per day (1 lb) at a stocking rate of 2 per ha (0.8/ac).

Para is unproductive under set stocking. It smothers legumes except Vigna hoseii.

(f) Cenchrus ciliaris (vars) (Buffel)

A grazing trial at Erap gave 0.6 kg (1.4 lb) liveweight gain per day in the first year but then broke down. Four beasts were grazed at each of the following rates per ha: 0.4, 0.8, and 1.2 (0.16, 0.32, 0.5 beast per acre).

Biloela Buffel with Glycine (Glycine javanica) was reasonably successful if allowed to seed (acting as an annual).

Generally Buffel grasses are not very successful and are subject to weeds.

(g) Pennisetum purpureum (Elephant grass)

Elephant grass and Para will grow if properly managed. Elephant grass is considered superior to Guatemala grass (Tripsacum laxum) for grazing. Some people feel that it is a nuisance because it spreads. It is also stated that it gets stemmy and consequently lowers production, but this was not substantiated.

Dry lowlands

It will compete with the serious weed Digitaria insularis.

(h) Brachiaria dictyoneura (humidicola) Koronivia

Koronivia grass persists and resists weeds, but in a trial only produced 50% of the liveweight gain of a Guinea/Setaria pasture.

V. Legumes

(a) Stylosanthes spp. (Stylo)

S. guayanensis establishes well without cultivation after burning. It is being introduced into native pastures in a number of places. There are no records of liveweight production from this legume.

Stylo is reported to give variable results and often does not last over two years. It is unpalatable when young, which helps it get established and also "helps it to look good". It should be grazed after seeding, or it goes out as it does not appear to perenniate.

Townsville lucerne was eaten out after a drought. It is generally unsuccessful because of the prevalence of tall grasses which need heavy grazing to allow the Townsville lucerne to grow. This kills the grass, and weeds invade.

(b) Desmodium spp. (Silverleaf and Greenleaf Desmodium)

Can be established on uncultivated land provided that it is not grazed for two years.

(c) Leucaena leucocephela (Leucaena)

In grazing trials Leucaena yielded 12,350 kg per ha (5,000 kg/ac) of Dry Matter at 21% crude protein. It has given a liveweight yield of 0.45 kg per day (1 lb) at 0.4, 0.6 and 0.8 beasts per ha over several months grazing (.16 to .32 beast/ac).

(d) Phaseolus atropurpureus (Siratro)

Grazing Siratro did better than a cutting regime which "casts doubt on the cutting technique". It gives variable and not very good results. It is very susceptible to ladybird attack.

VI. Weeds

In the Erap area flannel weed (Sida cordifolia) is common, especially after over grazing. Dichanthium spp. (probably Mandi blue) beats it by invasion and cattle will resume grazing.

Digitaria insularis is a vigorous-growing, completely unpalatable grass which constitutes a serious pest. It grows particularly well after cultivation.

QUEENSLAND

I. South Johnstone Tropical Pasture Research Station (Near Cairns.)

General

Considerable work has been done in classifying the soil types of the wet tropical coast areas so that results can be extrapolated. Classification is by vegetation which closely follows parent material. General recommendations are 250-500 kg per ha of superphosphate.

(2-4 cwt/ac) plus K. and trace minerals for satisfactory pastures. This recommendation varies little over a wide range of soil types. The need for P. is emphasised for any improved pasture establishment. Set stocking is not deleterious so long as it is not overstocking.

Growth rate

Growth rate of Centro is affected by maximum and minimum temperatures. The difference between the two is fairly constant at 12.8°C (23°F), but when the maximum falls below 25.5°C (78°F) and minimum falls below 12.8°C (55°F), growth stops regardless of other factors. The temperature curve happens to follow the rainfall curve, but it is not rainfall which has the effect. Similar effects are noted with other tropical legumes and grasses.

Recommended pasture for 3.000 mm. rainfall

Guinea (P. maximum var Guinea).
Centro (Centrosema pubescens) and
Stylo (Stylosanthes guayanensis)

seeded at 1.8, 2.3 and 0.9 kg respectively per ha is considered a standard pasture, and in addition for winter (cool period) a smaller area of Pangola (Digitaria decumbens) or Brachiaria decumbens, which can have nitrogen applied, is recommended.

N. equivalent of legume

It is stated that 378 kg of sulphate of ammonia (833 lb) is required to provide the equivalent of a good grass/legume pasture. This represents 80 kg N/ac.

There has been a tendency for pastures to be changed over the last ten years from Guinea/Centro (or Stylo in the wetter area) to Brachiaria decumbens and Para. The problem is not production, but the general slowing down of growth in the cool season.

Reasons for weeds in newly sown pastures

(a) Inadequate seedbed preparation
(b) Insufficient fertiliser
(c) Poor quality seed
(d) Not using a roller on some soils
(e) Unfavourable weather after planting

Value of mixed sward

A Guinea/Centro pasture produces similar pH, nitrogen and organic carbon content to the original rain forest in a 3,000 mm. rainfall area (120 ins).

Effect of legume

A Guinea grass/Green leaf Desmodium mixture produced a Dry Matter yield of only 150 kg (332 lb), whereas a Guinea grass/Puero mixture produced 2,056 kg (4,529 lb).

Embu (Panicum maximum var Embu)

Creeping Guinea (Embu) disappears under heavy grazing.

Liveweight production

A Guinea/Centro pasture grazed at different rates during hot and cold seasons produced:

from December to April at 5/ha (2/ac)	215 kg liveweight	(475 lb)
from April to December at 2.5/ha (1/ac)	150 kg	(332 lb)
	TOTAL 365 kg	(807 lb)

B. decumbens + 336 kg/ha N. (300 lb/ac) produces 1,120 kg/ha of liveweight gain (1,000 lb/ac).

B. decumbens with legumes produces 900 kg/ha of liveweight gain (800 lb). This grass has the additional advantage that it grows in the cool season (winter).

It was found that a B. ruziziensis pasture required 112 kg/ha N (100 lb/ac) to produce the same liveweight gains as a Guinea/Stylo pasture. Guinea grass is far easier to handle than B. ruziziensis because the latter seeds and then stops growing as it becomes cooler. Guinea has therefore replaced B. ruziziensis. Colonaic has also been discarded.

Setarias grow satisfactorily in areas with 1,270 to 2,030 mm. of rain, (50-80 ins) but once rainfall is above 2,000 mm. it is less productive than Guinea grass. Setaria splendida is superior to the others

in spite of a lower leaf/stem ratio. However, seed is difficult to collect, and only a small percentage germinates. The Setarias are generally not very good grasses: although they may give better winter yield they are inferior to Guinea grass in summer, especially if it is hot and dry. Commercial plantings have tended to decline in vigour.

Centrosema pubescens is a slow-establishing but good legume, provided that it has adequate supplies of the necessary minerals. Balalto is the superior variety, far outyielding the other varieties. It is under examination in a grazing trial involving Balalto centro, the "new" hairy Guinea grass, common Guinea, common Centro, Brachiaria decumbens and N. fertiliser (the last two to provide one source of winter grazing).

Endeavour Stylo makes more growth in winter than common Stylo (Schofield). Cook Stylo is also promising.

Siratro does not last in these wet conditions.

Glycine is not as good as Centro.

Leucaena is unsuited to the wet tropics. It is slow to establish and there are nodulation problems.

II. C.S.I.R.O. Townsville Pastoral Research Laboratory (Soon to be named the Davies Laboratory.)

This laboratory has a large team of specialists, each looking at one particular aspect of pastures and its various ramifications. Much of the research is basic and often quite highly sophisticated. Nevertheless there are a number of activities which could be useful to the South Pacific region.

Stylosanthes

Climatic conditions have been considered to find the suitability of adaptive material. By using numerical techniques, a very large number of varieties of Stylosanthes have been considered and the process is far quicker than the traditional testing in rows. An equatorial testing site in Cape York and a tropical site near Cairns provided varying conditions. Given a description of conditions, a computer can select the most suitable varieties of Stylo. Further testing is by grazing for 3 years rather than by hand cutting evaluation.

Stylo

In the equatorial north, where there are monsoonal conditions with 70 inches rainfall (1,800 mm.) a year, there is only an eight-month growing season owing to lack of rain in the other four months. There is need to establish a production pattern to find suitable plants. Siratro and Centro persist, but one worker reported that Stylo does not last more than 3 years under these conditions. Nevertheless, Stylo appears to be the most productive legume.

Setaria

Kazangula Setaria grows well and has produced large amounts of herbage. Where soils are poor under these climatic conditions (Cape York) phosphate becomes the most important factor and gave lineal growth responses to 17 cwt (850 kg) of superphosphate.

Brachiaria decumbens

Brachiaria decumbens seems the best grass agronomically and nutritionally and stays green longest, whereas Panicum maximum will grow but not very successfully. A grazing trial involving B. decumbens, Green Panic, phosphate levels, supplementary minerals and stocking rates is in progress.

Leucaena

A Leucaena species developed by C.S.I.R.O., Leucaena cunningham, is capable of producing 40% more Dry Matter than the commonly known and accepted Peruvian variety. At the same time, lateral branching and low mimosine content are being bred into this Leucaena. It is best planted in 8 feet (2.4m) rows after rotocultivating and application of a contact weedicide at planting. Leucaena is rhizobium specific. Once the stem is woody it can resist contact weedicides.

In order to allow establishment, Leucaena should not be grazed for the first year. It can then be grazed at up to 8 feet (2.4m) in height. A grazing system of 4 weeks on and 6 weeks off is best, provided that there is sufficient rain. This allows harvesting 5 times a year.

Pot testing for trace elements

It takes about 8 weeks to test a soil for all trace elements. Under suitable circumstances the laboratory would help supervise graduates in training for this technique before applying it in a country in the South Pacific area.

CONCLUSION

The description of pasture work in Papua New Guinea relates to an area with an annual rainfall of about 1,300 mm. For the Pacific this is relatively dry.

Native pastures are mostly Kunai (Imperata cylindrica) and although animal production of about 0.45 kg per day, and for longer periods 0.36 kg per day, is obtained it is a difficult pasture to manage and maintain.

The cost of establishing "improved pasture" as an alternative is about $A100 per acre ($A250/ha). These pastures do not do well without additional phosphorus, particularly for the legume component, but because the cost of P is high, there is some argument for straight grass pastures.

Para grass(Brachiaria mutica) grows well in new clearing under wet conditions but otherwise the "improved" grasses tend to be disappointing without careful management including fertilisers.

Stylo (Stylosanthes guyanensis) is the most promising legume, particularly as it can be established after a burn.

In tropical Queensland, the terrain has been classified by vegetation and soil type to allow extrapolation of research results to similar field conditions. Rainfall is about 3,000 mm.

Phosphorus is always necessary for establishing "improved" pasture.

The high value of legumes as a supplier of Nitrogen has been established. Centro (Centrosema pubescens) variety Balalto is claimed to be best.

Grass legume swards produce 365 kg/ha of liveweight per year (800 lb/ac) with a system of different stocking rates at different times of the year.

Guinea (Panicum Maximum) and Signal (Brachiaria decumbens) are the favoured grasses.

ISSUED IN THIS SERIES

		Classification
1.	Annual Conference of O.I.E. held in Paris 13th - 18th May, 1968. Report of S.P.C. Observer. September 1968.	Livestock Production and Health
2.	South Pacific Commission Publications Series. October 1968.	Publications
3.	Free Diving Without Breathing Apparatus - Its Accidents. March 1969.	Public Health
4.	"A" Level : Australia's Notification on Bovine Pleuropneumonia Regulations. March 1969.	Plant and Animal Quarantine
5.	Study Tour to Noumea, Brisbane, Territory of Papua and New Guinea and British Solomon Islands Protectorate. March 1969.	Tropical Crops
6.	"A" Level : Agricultural Education - Bulletin N° 1. April 1969.	Agricultural Education
7.	Introduction and Spread of Culicoides and Other Insect Species by Aircraft. May 1969.	Public Health
8.	Diarrhoeal Diseases in Adults. May 1969.	Public Health
9.	"A" Level : Agricultural Education - Bulletin N° 2. May 1969.	Agricultural Education and Extension
10.	"A" Level : Agricultural Education - Bulletin N° 3. November 1969.	Agricultural Education and Extension
11.	Agricultural Extension Workshop - Western Samoa. November 1969.	Agricultural Education and Extension
12.	Asian-Pacific Weed Science Society. December 1969.	Tropical Crops
13.	The Status and Potential of the Chilli Industry in the Solomon Islands. December 1969.	Tropical Crops
14.	Manpower Planning in the South Pacific. March 1970.	All

15.	Fibreglass Water Tanks. April 1970.	Public Health Engineering
16.	U.N. World Youth Assembly. May 1970.	Social Welfare and Youth
17.	News and Views from the Journals. June 1970.	Public Health
18.	Acute Rheumatism and Chronic Rheumatic Carditis in Fiji. June 1970.	Public Health
19.	Public Health Problems of Gonorrhoea and Syphilis. June 1970.	Public Health
20.	Clinical Aspects and Diagnosis of Leprosy. June 1970.	Public Health
21.	News and Views from the Journals 2 : On Insects and Their Control. June 1970.	Public Health Environmental Health and Vector Control
22.	Breadfruit Diseases in the South Pacific. June 1970.	Tropical Crops
23.	Second World Consultation on Forest Tree Breeding. June 1970.	Forestry
24.	Agricultural Research in the South Pacific. July 1970.	Tropical Crops Livestock Production and Health
25.	Crown-of-Thorns Starfish. July 1970.	Fisheries
26.	Counter-Attack - Crown-of-Thorns Starfish. September 1970.	Fisheries
27.	A Simple Field Test for Determination of Salinity of Water Supplies. December 1970.	Public Health
28.	Asian Coconut Community. January 1971.	Tropical Crops
29.	O.I.E./F.A.O. Regional Conference on Epizootics in Asia, the Far East and Oceania. January 1971.	Livestock Production and Health
30.	Plant Pest Control. January 1971.	Tropical Crops Plant and Animal Quarantine

31.	The Effect of Cultural Method and Size of Planting Material on the Yield of Colocasia Esculenta. February 1971.	Tropical Crops
32.	Shell-fish and Public Health. April 1971.	Public Health Engineering
33.	Weed Control. August 1971.	Tropical Crops
34.	Taro. August 1971.	Agricultural Research
35.	Transmission of Virus Samples. August 1971.	Plant and Animal Quarantine
36.	Amyotrophic Lateral Sclerosis and Parkinsonism-Dementia in Guam. September 1971.	Mental Health
37.	Training Programmes for Out-of-School Rural Youth. March 1972.	Agricultural Education and Extension
38.	Control of Aedes aegypti, the Vector of Dengue. September 1972.	Vector Control
39.	Coconut Water as an Emergency Parenteral Fluid. September 1972.	
40.	Viral Hepatitis. October 1972.	Hepatology
41.	Biological disc treatment of waste waters. December 1972.	Public Health Engineering
42.	The Monitoring of Sewage Treatment Plants. December 1972.	Public Health Engineering
43.	The Fifth FAO Regional Conference on Animal Production and Health in the Far East. December 1972.	Livestock Production and Health
44.	The Septic Tank. January 1973.	Public Health Engineering
45.	How to deal with the sludge produced by sewage farms in the South Pacific. January 1973.	Public Health Engineering
46.	The convenience of the metric system. February 1973.	Public Health Engineering
47.	Useful references for animal production and agricultural extension workers of the South Pacific Commission territories. March 1973.	Animal Production

48.	Twelfth World Congress of Rehabilitation (Sydney, Aug. 27 - Sept. 1, 1972). March 1973.	Mental Health
49.	Primary Amoebic Meningo-Encephalitis. April 1973.	Epidemiology
50.	South Pacific Agricultural Extension Survey - 1967. April, 1973.	Agricultural Education and Extension
51.	Collection and Shipping of Serum Specimens for Antibody Studies. May 1973.	Public Health
52.	Fruit Cultivation. June 1973.	Tropical Crops
53.	Recent Developments in Education in the South Pacific. August 1973.	Education
54.	Shellfish Poisoning in the South Pacific. February 1974.	Public Health Fisheries
55.	Special Project-Vegetable Production in the South Pacific. January 1974.	Tropical Crops
56.	Comments on Experiments Recently Undertaken in some Pacific Islands on certain varieties of Vegetables. March 1974.	Tropical Crops
57.	Not yet available in English	
58.	Some Aspects of Pasture Research and Development. April, 1974.	Livestock Production