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THE QUALITY OF NATURAL TROPICAL GRASSLANDS

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The tropics proper are contained between 23½° N and S of the equator and the subtropics extend beyond the tropics to about 35° N and S. Most tropical pasture species disappear beyond latitudes 30° N and S.

Tropical temperatures are usually very high in summer unless modified by proximity to the sea or inland lakes or belts of rain forests where daily variations will be less. At Entebbe on the shores of Lake Victoria in Uganda the mean daily temperature range is 8.5°C and the mean maximum 20.6°C, while at Soroti, 160 km north east and about 60 metres lower, the daily range is 12.5°C and the mean maximum is 30°C. Temperatures decline with increasing altitude and in equatorial regions it approximates 2°C for each 300 metres (1000 feet) altitude. Thus in many tropical countries there are highland areas where temperate pasture species supercede the tropical ones.

Rainfall is usually heavy at the Equator in the equatorial calm. The trade winds affect rainfall outside this belt and usually travel east to west giving a heavy rainfall on the eastern side of the land masses with decreasing rainfall to the west. In Oceanic areas rainfall at sea level may be small if elevated land masses do not occur nearby.

Kendrew (1961) recorded the rainfall pattern of the continents. He recognised

(a) an equatorial pattern, within a few degrees of the equator, of heavy rain
(b) two tropical patterns—one of rain in the hottest months in the neighbourhood of the Tropics of Capricorn and Cancer, and a second bi-modal pattern between these zones and the equator, common to Kenya and Uganda
(c) a monsoonal pattern with a marked maximum in summer and a long dry season. This latter pattern imposes severe stress on both pastures and cattle, and is common in tropical Australia.

The quality of the natural grasslands in the tropics is influenced to varying degrees by the type of soil in which the grasslands grow. In the higher rainfall areas the soils as a group are generally severely leached and are deficient in nutrients, especially nitrogen and phosphorus, and some minor elements. In the drier areas some of the heavy clays which resist leaching, are quite fertile with respect to nutrients and this is reflected in the quality of their pastures. The black earths and cracking clays generally support superior pastures for livestock by reason of their high calcium and phosphorus contents, and the "Birch effect" provides seasonal nitrogen. Areas which are periodically water-logged, however, may be poor in nutrients. Many of the African "mbugas" or valley bottoms are in this category.

Pressure on land from cash crop and plantation agriculture in the tropics has usually relegated livestock production to non-agricultural land. Consequently these latter lands are often of poor fertility, have a difficult climatic pattern, need extensive clearing or are so far removed from centres of population that there are transport difficulties. Land values are consequently comparably low which is a feature usually necessary to maintain a viable extensive livestock industry. There are some exceptions, where high quality animals can be bred and sold from fertile advantageously situated properties but such areas are in the minority.

Cattle liveweight performance whilst grazing most of these natural grasslands has a good deal in common. There is usually a small weight loss immediately after the break of the season when the cattle seek the young shoots of the rejuvenated grass on burnt country and begin to scour and the old fibrous rain-soaked material is unattractive (Shaw 1961). Thereafter there is a rapid weight increase over the next few months corresponding with the seasonal growth of the dominant pastures and finally decline after the pasture begins to mature. This gives animal liveweights which rise in steps, gradually increasing over a series of years. (Alexander and Chester 1956; Stubbs and Arbuckle 1962.)

The Australian beef and wool producing industries have developed to their present level mainly from the grazing of livestock on natural pastures. This is particularly so in Queensland where development of improved or sown pastures is relatively recent and even now, although an all-time high of some 2.6 million hectares (6.3 million ac) are in sown pastures, this only represents about 1.5% of the area of the State. Queensland has only 6% of land which receives more than 1524 mm (60 in) of rain a year. There are only about 1.2 million hectares (3 million ac) of wet tropics and 92 million hectares (227 million ac) of dry tropics in Queensland north of the Tropic of Capricorn. If Queensland's area under crop is accepted at 2.2 million hectares (5.5 million ac), the total area of natural grazing lands must exceed 162 million hectares (400 million ac). Consequently we have an obligation to direct a good deal of attention to conservation and efficient utilization of our natural grasslands and step up research in range management.

Queensland's natural pasture lands

With Queensland's annual rainfall varying from a mean of over 3810 mm (150 in) north of Tully to less than 127 mm (5 in) near Haddon's Corner, a range in geological history from pre-Cambruim to recent: a range in elevation from sea-level to 1828 metres (6000 feet) and a daily mean temperature range from 21°C at Stanthorpe to 31°C at Camooweal, there is a great diversity in natural grazing areas.

The extent, vegetation and animal productivity of (a) Wallum (b) Rainforest (c) Spear-grass (d) Tropical tall grass (e) Brigalow (f) Blue grass downs (g) Desert country (h) Mitchell grass downs (i) Mulga and (j) Channel country were described.

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EFFICIENT UTILIZATION OF PASTURES FOR BEEF PRODUCTION

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Queensland has a tremendous asset in many of its adapted durable native pasture systems, which have been abused and neglected but still contribute significantly to beef production in this State. Their weaknesses tend to be emphasised and their strengths ignored. Graziers really have not learned to live with their native pastures. There is a tendency to think about their destruction and replacement with species which are not as well adapted, often less durable and certainly higher in cost.

The most significant contribution from pasture research has been the work on Townsville stylo because of the basic concept of at least endeavouring to preserve the native grass whilst introducing at relatively low cost a species that might increase dry matter yield, improve quality and decrease the period of weight loss during the second half of the year.

Pasture improvement is coloured by the fact that Queensland enjoys the luxury of a low-cost structured beef industry. A pasture improvement programme might look attractive from a business investment point of view, but looked at from the total industry situation, such programmes, if widely adopted, inevitably add to the cost structure of the industry. There is a commitment to high levels of inputs in terms of fertilizer, livestock purchases, etc., which inevitably makes the enterprise and the industry more vulnerable to rising costs. Biological efficiency of production is improved, but it is suggested that in the long term this may well be at great expense in terms of our survival in world markets.

Efficiency of production can be increased without costly inputs. In the first instance it has been adequately demonstrated that technology is available to increase significantly the reproductive performance of our breeding herds without high-cost supplementation. Herd health management combined with simple management techniques designed to fit the reproductive cycle to the available feed will yield a highly economic response because the inputs are low. In the north, the cheaper non-protein nitrogen supplements and in certain areas phosphorus may be an essential part of such a programme. Special purpose improved pastures, fodder crops and crop residues have a specific role in this management system where they are available. Another major advance which can be made at little cost is the genetic improvement of breeding herds by crossbreeding and more objective selection for the more important productive traits.

There is a dearth of native pasture and range management research which is in marked contrast to the emphasis which is being placed on the evaluation of new species. A survey of the results of the large number of well executed and well documented grazing trials shows a lack of predictive value. The reasons for changes in animal productivity need to be understood in order that extrapolation can be made to a variety of environmental conditions.

Studies of total animal-pasture systems have been neglected in favour of the fragmented approach. One reason proposed has been the lack of sufficient basic data to allow simulation techniques to be used. If this reasoning is maintained basic data will always be lacking. One of the real advantages of modelling, including the use of simple models, is the highlighting of major deficiencies in knowledge.

We should not be pessimistic about the long-term future of the Queensland beef industry because we are better situated than the southern States, simply because a breeder unit can run more cheaply. If this advantage is to be maintained, developments requiring high cost inputs need careful consideration. First priorities should relate to improving efficiency of production by the adoption of low-cost management techniques yielding the maximum response per unit cost. Initially this can be achieved by improved brandings, lower mortalities, improve the genetic merit of herds. Improved pasture development, provided it complements production from indigenous species, follows as the next priority in development. The pasture revolution is still beyond the horizon in a large area of Queensland though searches, such as those by Burt and Isbell, give some cause for optimism.

THE EFFECTS OF SOME MANAGEMENT PRACTICES ON PASTURE PRODUCTION

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The production of any given animal depends on feed quality and feed intake. Feed quality is determined by its digestibility, crude protein content, mineral content, acceptability or palatability and the absence of harmful substances. Many of these factors are related to each other and to intake.

Choice of pasture and grazing pressure are two management practices which have a profound effect upon pasture production and profitability. The influence of these practices is illustrated with some results from experiments at the C.S.I.R.O. Research Station, Narayen, Mundubbera. The experimental pastures (all fertilized with molybdenised superphosphate) were located on granite country cleared in 1966 or 1967 of narrow-leaf ironbark (*Eucalyptus crebra*) and associated trees. The average rainfall of 700 mm (28 in) is erratic and of predominantly summer incidence, but droughts may occur at any time of the year and light frosts are common.

For spear grass country such as at Narayen, the types of pasture to choose from are:

1. Native pasture—spear grass (*Heteropogun contortus*) dominant
2. Native pasture with a sown legume, e.g. Townsville stylo (*Stylosanthes humilis*)
3. Sown pasture

A well planned property would have areas of each of these pasture types and in addition there might be areas for grazing crops, but these have been excluded from consideration here.

ANIMAL PRODUCTION

To compare the productivity of these types of pastures there is only one measure, viz. animal production. However, in order to analyse production factors it is necessary to determine which pasture attributes play a role in animal production.

Live weight gains (LWG) of steers between 9 and 21 months old from November 1970 till November 1971 on the pasture alternatives shown above are presented in Table 1.

The pastures were sown in early 1968. All were fertilized with Mo-superphosphate and the sown pastures consisted of buffel grass (*Cenchrus ciliaris* cv. Biloela) alone, or with Siratro (*Phaseolus atropurpureus*), or with nitrogen fertilizer (168 kg N/ha/year as urea in three equal dressings).

TABLE 1

Live weight gains of steers on pastures fertilized with Mo-superphosphate at the Narayen Research Station from November 1970 till November 1971

Pastures	Stocking rates					
	2.2 1.1	1.5 1.7	1.1 2.2	0.9 2.8	0.7 3.4	0.5 steers/ha 4.5 acres/steer
Buffel grass alone					96	
Buffel grass with Siratro			163		173	184
Buffel grass with 168 kg N/ha	128	158	162			
Native pasture						88
Native pasture with Townsville stylo				135		

Points of interest in Table 1 are:

1. There was little difference in animal production between native pasture and buffel grass on its own.
2. Townsville stylo sown into native pasture and grazed at a higher stocking rate gave about 40 kg more LWG per head than did native pasture on its own.
3. Siratro with buffel grass at the equivalent stocking rate, yielded 80 kg more LWG than did buffel grass on its own.
4. Buffel grass with Siratro and buffel grass with 168 kg N/ha grazed at the same stocking rate gave similar LWG.

Significant differences were also found in the carcass quality of animals slaughtered from the different pastures. First quality carcasses were obtained from only buffel grass with Siratro, or with nitrogen fertilizer, all others being second or third grade. Gross income per head ranged from $125 on Siratro to $85 on buffel grass only. With the cost of a weaner estimated at $90, there was a loss on animals grazing on native pasture, buffel grass only and with nitrogen. A preliminary economic analysis of our results shows that buffel grass and Siratro is a profitable pasture.

Stocking rates also have a profound effect on profitability. Under stocking and over stocking are both likely to result in unprofitability. Too low a stocking rate leads to under utilization and thus low returns on investment and too high a stocking rate may lead to a lower quality carcass and high investment in terms of capital per unit area.

PASTURE-ANIMAL RELATIONS

Since May 1969, these pastures were sampled every four weeks for total dry matter on offer, botanical composition, green/dead proportions of the major components, and digestibility and chemical composition of the green fractions.

The crude protein (CP) content of green material of the major components over a period of one year is shown in Table 2.

The minimum CP content for maintenance is generally accepted as 7 percent. Spear grass and buffel grass grown alone were just above, at, or below this level from the beginning of March till June and May respectively. Subsequently the levels rose, but the green material of all these components was very scarce during the cool months of the year and there was insufficient to satisfy the animal's needs. Buffel grass grown with Siratro had higher CP levels, particularly during the cooler months. Siratro had always more than adequate CP levels, but after the first frosts there was very little of it.

TABLE 2

Crude protein contents of green material of the major components taken at four week intervals from November 1970 till September 1971

Green material of	Nov	Dec	Jan	Feb	Mar	Mar*	Apr	May	Jun	Jul	Aug	Sep
Spear grass	11	9	9	10	8	7	6	6	7	11	13	12
Buffel grass grown alone	11	9	9	10	8	8	6	8	13	15	16	13
Buffel grass grown with Siratro	11	12	8	13	9	10	9	10	17	18	19	17
Siratro	28	19	21	22	19	17	12	17	26	30	26	27

*Sampled twice in March

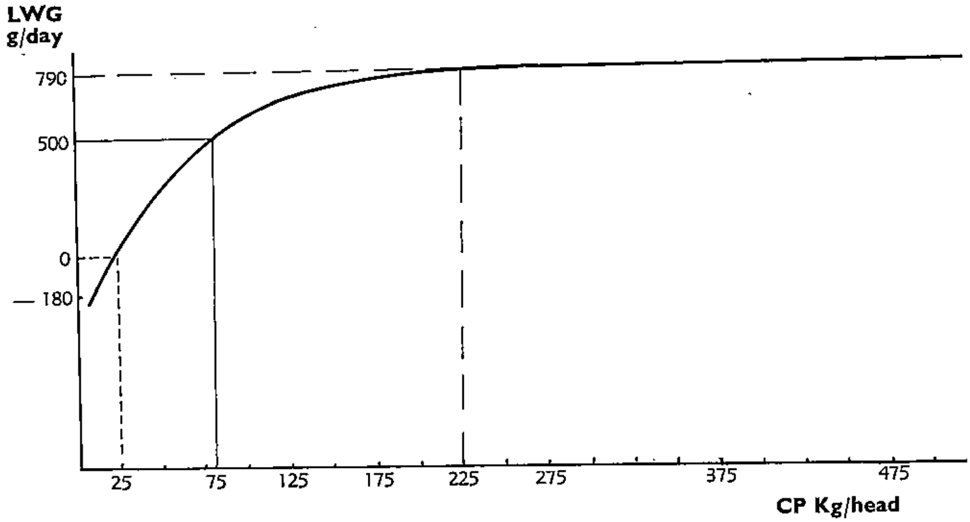

FIGURE 1

Relation between L.W.G./hd and C.P. in green material available at start of 4-weekly grazing period

Monthly LWG of steers on all buffel grass pastures was not related to total dry matter, nor to total digestible nutrients, nor to total CP on offer. However, there was a good relation between LWG and green grass, digestible nutrients in green material and CP in green material on offer. The relations were all of the same general form as shown in Figure 1 for CP in green material. There are three important points on this graph:

1. The mean maximum LWG of 790 g/day was obtained at 225 kg CP/head available during a four week grazing period; more CP did not result in higher daily LWG.
2. LWG was negative when CP was less than 25 kg/head.
3. LWG of 500 g/day (a little over 1 lb) was obtained at 80 kg CP/head.

This graph also shows that there was better utilization of CP on offer at lower levels than at higher levels. In theory, a pasture should be managed around the point of 225 kg CP/head; if there is more the pasture is undergrazed, if there is less it is overgrazed. In practice, however, this is not possible, unless the manager resorts to flexible stocking rates and supplementary feeding, or to conserving fodder when there is an excess. For beef production in this environment this may not be a profitable undertaking.

Pasture measurements of CP and digestible nutrients available in green material have given acceptable predictions of actual LWG, particularly in summer. During autumn and winter, when predictions were less accurate, the digestibility and CP of the green material were near or below the maintenance level, so that the amount may be less important.

SELECTION OF PASTURE SPECIES

In the case of sown pastures it is also important to select species which are the most productive, as is illustrated in the following example (Table 3).

Five Siratro based pastures of 0.4 ha, were set stocked with two steers each for 115 days from January 1972. Total dry matter, Siratro content and CP percentage

TABLE 3

Pasture parameters and animal production on five grass/Siratro mixtures, set stocked for 115 days from Jan. 1972 at 5 steers/ha.

Grass grown with Siratro	Dry matter			CP % green grass	L.W.G.		
	Total	Siratro					
	kg/ha	%	kg/ha		kg/ha	kg/ha	g/day
Sabi Panic (*Panicum maximum*)	5346	16	868	12.8	55	272	478
Petrie green panic (*P. maximum* var. *trichoglume*)	8868	21	1887	9.6	60	296	522
Nunbank buffel (*Cenchrus ciliaris*)	5494	19	1043	12.3	59	292	513
Gayndah buffel (*C. ciliaris*)	4659	13	594	11.4	33	163	287
Pioneer Rhodes grass (*Chloris gayana*)	3618	17	606	10.5	33	163	287

of the green grass were measured prior to grazing. The heavy stocking rate was aimed at full utilization of the herbage over a short time. Animal performance under these conditions is a function of total available material and quality of the material. The pastures differed greatly in all respects and on the basis of animal performance they can be divided into two groups: a) the two panics and Nunbank buffel with nearly twice the LWG of b) rhodes grass and Gayndah buffel. Animal performance was linearly related to the amount of Siratro up to 1000 kg/ha, but more Siratro did not result in more LWG.

It is of interest to note that the LWG of nearly 300 kg/ha in 115 days is about twice as much as that obtained on the same type of pasture in a whole year at one fifth of the stocking rate. The reason is that at 5 steers per ha most of the herbage was utilized before deterioration set in. On year-round grazing a larger proportion of the herbage goes unused, or is consumed after it has lost much of its feeding value. A management system based on full utilization while the pasture is at its best would be practicable where a grazing crop like oats is available to continue good daily gains after the pastures have been grazed out. For this system to be successful animals must be in good condition for slaughter before the grazing crop has been utilized.

BOOK REVIEW

Grasses and Legumes in British Agriculture. Edited by Prof. C. R. W. Spedding and the late Mr. E. C. Diekmahns, and published by the Commonwealth Agricultural Bureaux 1972.

The book written by 43 contributors contains 511 pages and 16 plates, and is divided into 46 chapters grouped into four parts (Introduction, The Grasses, The Legumes, Comparative Assessment of Species).

The dominant theme throughout the book is that the legumes and grasses in use throughout Britain, are accepted and treated as crops. In this case, the species are sown and used selectively in relation to an overall farm year requirement. The strength of the book lies in the fact that the authors, having accepted the species as crop plants, set out to describe the attributes of each one. This has been done extremely well.

The introduction comprising 5 chapters, is primarily concerned with the environment (soil, climate, light). Material presented is limited to that pertinent to British conditions. In this, the authors have drawn attention to the available soils and their delineation, and the meteorological records for Britain with respect to