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THE PROBLEMS OF PASTURE MANAGEMENT IN THE DEVELOPMENT OF THE LIVESTOCK INDUSTRY IN GUYANA

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Introduction

"Ruminant livestock are important to nearly all world areas. Their role in the future of mankind is certain to become progressively more important. Increasing widespread malnutrition, ruminants potential for utilising available land masses suited only to livestock production and the need to increase foreign exchange earnings are principal reasons for their importance ..."

This excerpt from Christiansen (1972) adequately summarises the role ruminant livestock can play in Guyana's development. For general purposes Guyana can be divided into four distinct geographical areas in which ruminant livestock production is attempted:

1. The coastal region, 270 miles long extending from the Orinoco delta on the west, to the Corentyne river on the east - and varying from 10 to 40 miles in width, comprises 4 per cent of the total land areas. Much of this land is below sea level and is protected from flooding by sea walls and drainage systems. About 70 per cent of the country's cattle population are to be found in this region grazing extensive swamp lands and harvested rice fields. The soil in this region is essentially fertile - an alluvial plain.

2. The Intermediate Savannah region extending 60 to 90 miles from the coast at a height of some 80 to 90 feet above sea level and covering an area of approximately 3,800 sq. miles between the Demerara and Corentyne rivers. The area is disected by numerous rivers and creeks which have belts of forest alongside them. The natural vegetation on the savannahs consists mainly of highly fibrous and relatively unpalatable grasses. The principal genus is *Trachypogon* in association with several species in the genera *Andropogon, Axonopus, Paspalum* and *Panicum*. The land is considered 'marginal' with soils which are broadly classified as 'brown sands' which range in texture from white sand (Tiwiwid) and pale yellow sands (Tabela) through loamy sands (Kasarama) to sandy loams (Ebini) (Brinkman, 1964). There are relatively small numbers of cattle in this region though the possibilities for expansion in the cattle sector appear considerable.

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3. The North West Region - an essentially mountainous area of some 4,000 sq. miles with a relatively high rainfall pattern (110 inches per annum). The soils appear to be extremely fertile but do show rather high levels of manganese and aluminium. The area supports a rather small population but is currently involved in intensive and rapid agricultural development with cattle and small ruminant herds.

4. The Rupununi Savannahs is southermost Guyana. These savannahs are among the many vast stretches of open grassland in the northern region of South America. The area supports about 25 per cent of the country's cattle population. Ranching is the main industry in the Rupununi. The climatic limitations of the area with 5 months of floods and 7 months dry weather consecutively (annual rainfall 60 inches in one season) which is unlike the bimodal rainfall distribution of the other three regions mentioned - are probably more damaging than relatively poor soil characteristics. The fact that this area is essentially isolated from the coastland with all imports and exports being achieved by aircraft limits the kind and extent of improvements that can be brought to the region.

Regional Characteristics and Animal Production

The Coastal Savannahs

Natural vegetation: Situated essentially below sea level the coastal swamp savannahs are seasonally flooded with belts of forest on higher ground and on the fringes of creeks and rivers. The soils range in texture from heavy black clay in lower areas to sandy loams in the forested islands and belts. The vegetation is extensive savannahs with the main species being *Hymenache amplexicaulis* (bamboo grass), *Leersia hexandra* (twine grass), *Soleria pterota* and *Echinochloa polystachya* (Missouri grass) in association with numerous sedges mainly bisibisi (*Eleocharis* sps). The main legume found growing under swamp conditions is *Vignea luteola* (wild bora) which appears resistant to waterlogging.

The rainfall pattern on the coastal savannahs is bimodal in distribution as follows:

Long wet season - mid April to mid August
Long dry season - mid August to mid November
Short wet season - mid November to end of January
Short dry season - early February to mid April.

This pattern being repeated in the Intermediate Savannahs and Northern West regions. During the wet seasons the coastal savannahs appear to be a veritable ocean of water with cattle seeking refuge on the limited 'high land' areas, and during dry spells a waterlogged condition tends to persist in most of the area. Although cattle manage to live and grow under these harsh conditions with marketable weights being achieved in three to four years, conception rates are low (35 to 50 per cent) and calf mortality is rather high (about 25 per cent). The quantity of high ground is generally insufficient for development of improved pastures capable of carrying reasonable numbers of animals during the wet seasons. Extensive drainage is rather costly and can seldom be justified for beef production purposes though for purposes of dairying it may be more feasible.

Higher quality grasses which can be used under unimproved conditions include *Brachiaria* sp (tanner grass), *Brachiaria mutica* (para grass),

and *Echinochloa pyramidalis* (antelope grass) which compete reasonably with native species, thus shortening the time period to market by increasing the carrying capacity of the swamp savannahs which now are about three to five acres per animal.

Vegetation after drainage: In areas which are subjected to some drainage natural ingressions of *Axonopus compressus* (carpet grass), *Paspalum conjugatum* (sour grass), *Cynodon dactylon* (Bahama) and *Elucine indica* (fowl foot) are observed. Pasture grasses which can be introduced in drained areas include *Digitaria decumbens* (pangola), *Echinochloa pyramidalis* (antelope), *Brachiaria mutica* (para), *Brachiaria* sp. (tanner) and *Pennisetum purpureum* (elephant). Limited success has been achieved with *Panicum maximum* (guinea grass).

Pasture legumes: Legumes which have been found to grow well in association with the above on drained land areas include *Pueraria phaseoloides* (Kudzu or puero), *Calapogonium mucunoides* (calapo), *Centrosema pubescens* (centro), and *Stylosanthes guyanensis* (stylo). *Desmodium adsendens* is usually found as a volunteer species particularly in lighter clay pastures. Management of kudzu is critical when grazed in association with many improved pasture grasses. Its relative unacceptability in relation to the more palatable grass species (due perhaps to its extreme hairyness) tends to encourage its dominance in most grass swards and occasional slashing is almost mandatory.

The grazing management of planted pastures on drained coastal soils is critical since mismanagement (overgrazing or undergrazing) results in serious ingression of weed grasses particularly *Paspalum virgatum* (razor grass) and *Sporobolus indicus* (iron or smut grass) two species which are extremely difficult to eradicate, seed profusely and are generally useless for grazing purposes. The fact that they are both somewhat responsive to increased fertility and resistant to mechanical clipping are further reasons for concern. The problem of invasion by these weed grasses is particularly significant in pangola grass pastures. Tanner and antelope pastures are much more resistant to weed invasion than most other species. This is due to the dense swards they form under a wide variety of soil and climatic conditions.

Pasture utilisation: The maximum use of coastal pastures during wet and dry periods is often difficult to achieve. The swampy nature of undrained savannahs require animals to forage in 1 to 3 feet of water in areas heavily infested with the sedge bisibisi *(Eliocharis mutata)*. The utilisation of 'abundant' growth by the animal under these conditions is hardly feasible. During the dry seasons when much of the water has receded animals make most use of the Missouri grass *(Echinochloa polystachya)* which then appears quite prevalent.

On drained areas maximum growth of pastures is observed during the wet periods but soggy nature of the land results in much damage to grass swards and great wastage of forage material by trampling. The high water content of material consumed precludes the animal from obtaining its required daily dry matter intake for maximum production. During the dry seasons soil water is at a premium, growth is reduced though forage quality from the point of view of dry matter intake is enhanced. Conservation techniques involving hay and silage making during periods of maximum growth can also be problematic since it is often difficult to put machines on the land during the peak of the rains. Though forage

conservation techniques are not generally practised in Guyana, the production of silage might be more feasible than hay making, since the unpredictable weather during wet periods might not permit the proper drying of hay in the field resulting in spoilage of the harvested material.

The Intermediate Savannahs

Natural vegetation: The Intermediate Savannahs are disected by rivers and creeks which have belts of forest alongside them. There is often a sudden transition from forest to savannah and the latter is an extensive, undulating grassland except for occasional "bush islands" of trees (mainly *Curatella americana* and *Byrosoniona canifolia*) and numerous defunct anthills. The natural grassland vegetation consists mainly of highly fibrous and relatively unpalatable grasses. The principal genus is *Trachypogon* in association with several species in the genera *Andropogon, Axonopus, Paspalum* and *Panicum* (Holder, 1972).

Legumes such as *Desmodium barbatum, Alysicarpus vaginalis, Zornia diphyla* and *Crotalaria* sp. are found locally but when subjected to reasonable grazing pressures they do not survive (Mayers, 1969). *Indigofera hirsuta* was introduced into the area at Ebini during the early 1960's and has become quite naturalised and adapted to savannah conditions.

Utilization of the native savannahs: The dominant species on the savannahs *(Trachypogon plumosus)* and *Andropogon leucostachyus)* are severely deficient in phosphorus and available calcium and utilisation for production purposes without mineral supplementation is impractical (Holder, Schoonover and Mott, 1973). Zinc has also been found to be a limiting nutrient in some areas (Legg & Sears, 1960).

Burning of natural grassland has long been a management tool of cattle graziers throughout the tropical world. The resulting improvement in the quality of the forage on offer to ruminant livestock by this technique has also been obtained by the use of mowers moreso on improved grass swards (clipping or brush cutting). Figures 1 and 2 show both the species and management effects (burning and cutting) on IVOMD[1] of natural savannah grasses and Figures 3 and 4 show similar effects on crude protein contents. It can be observed that digestibility and crude protein contents of mature savannah grass are quite low (25 per cent IVOMD and 4 per cent crude protein). However, IVOMD values were acceptable for cow/calf type operations up to the 4-week period of regrowth with burning. Crude protein levels were above nitrogen balance up to the 6-week period of regrowth. Burning as a management tool might have some potential value in the utilisation of savannah swards though it is doubtful whether slashing could equally be effective.

Improving the native savannahs: The plant nutrient most critical for the growth of improved grasses on the Intermediate savannahs is phosphorus (Downer, 1972) and attempts to introduce strains of grasses and legumes usually require fertilisation with phosphates and nitrogen.

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[1] *In Vitro* Organic Matter Digestibility.

Figure 1. Species Effect on IVOMD of *T. plumosus* and *A. lencostachyus* over a 10-Week Regrowth Period.

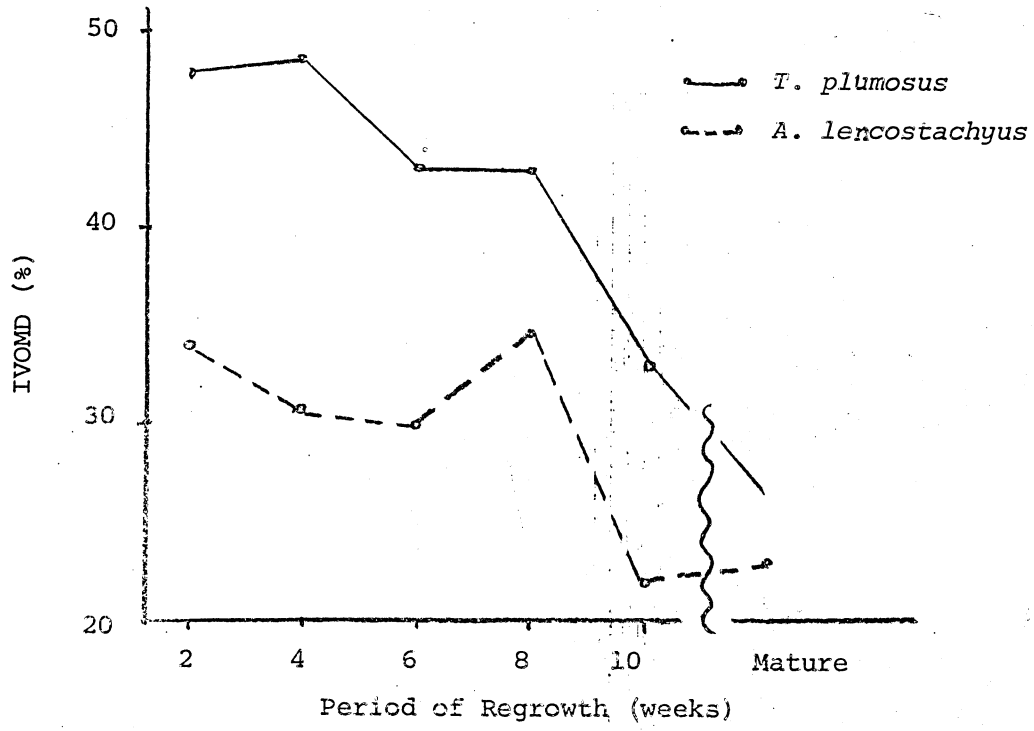


Figure 2. Management Effect on IVOMD over a 10-Week Regrowth Period.

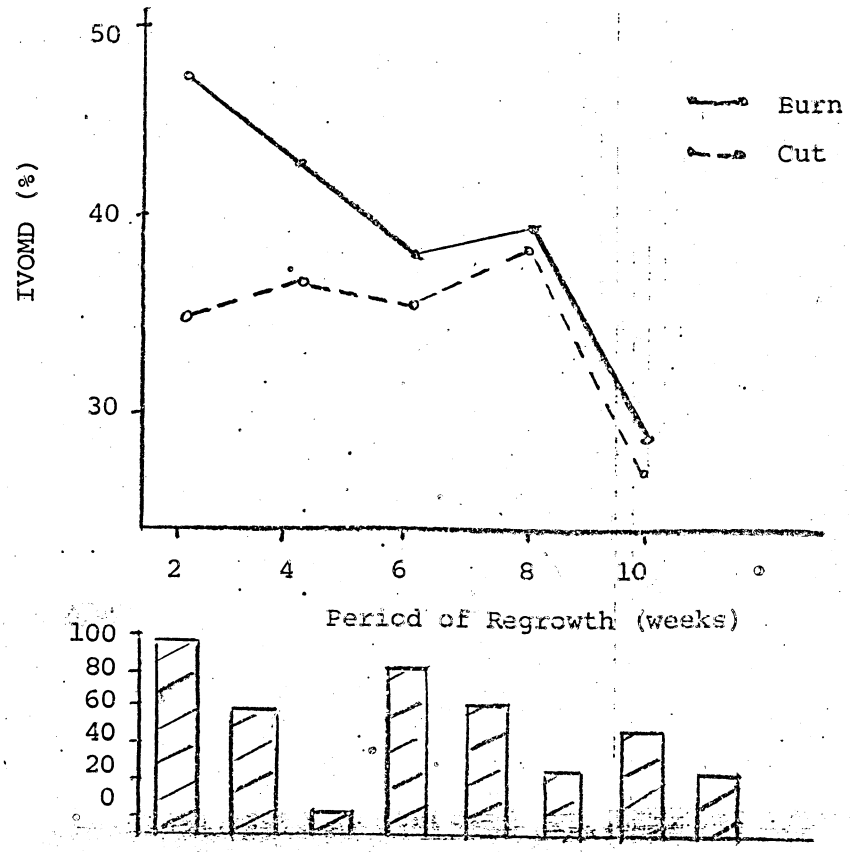


Figure 3. Species Effect on Percent of Crude Protein of *T. plumosus* and *A. lencostachyus* over a 10-week Period of Regrowth.

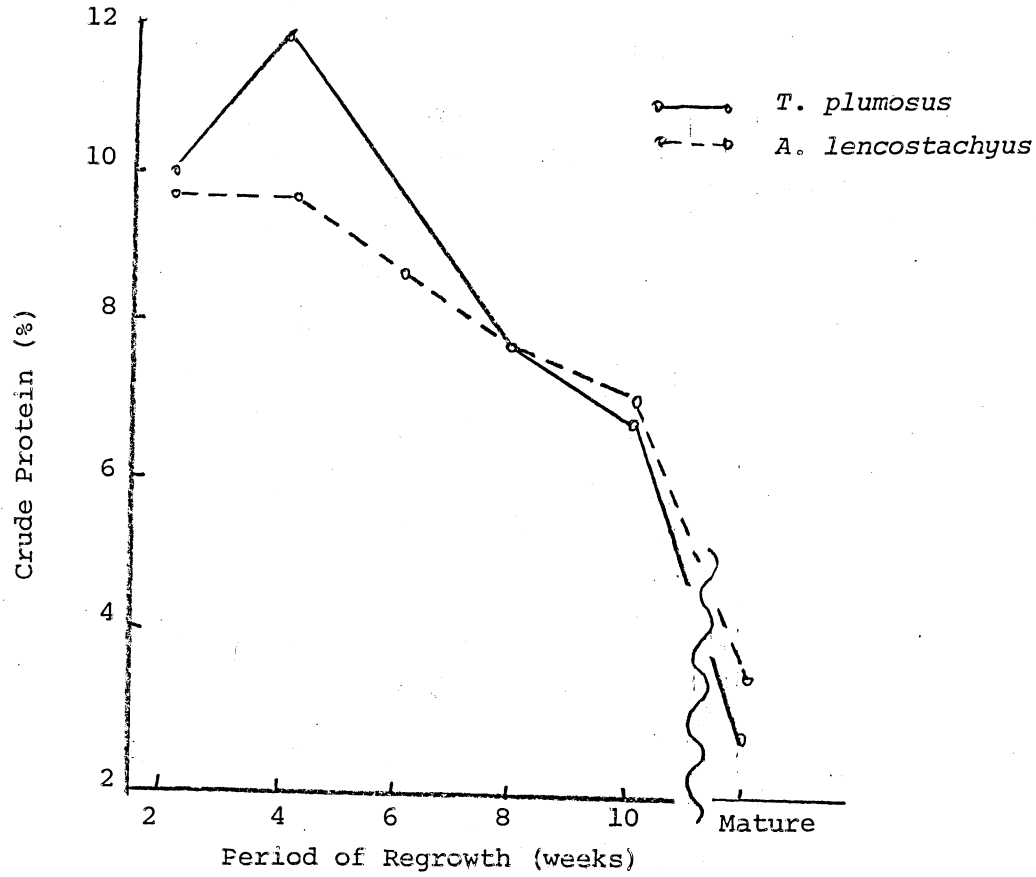
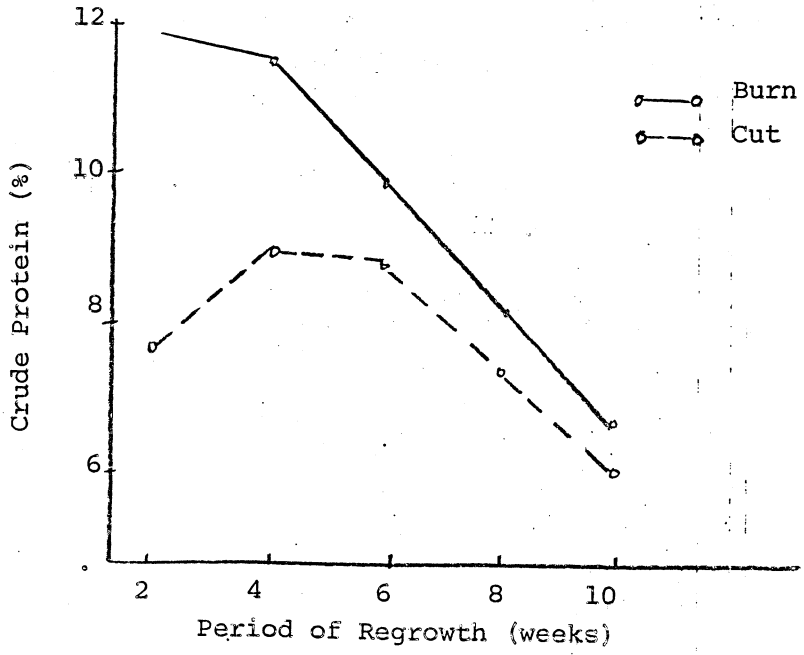


Figure 4. Management Effect on Percent Crude Protein in Herbage over a 10-week Period of Regrowth.



Grasses introduced into the area and used for grazing are *Digitaria decumbens* (pangola), *Cynodon dactylon* (bermuda), *Melinis minutiflora* (molasses), *Panicum maximum* (guinea), *Brachiaria* sp. (tanner), *Digitaria setivalva* (PI 299795) and many others which have so far not been considered beyond the nursery stage. *Cenchrus ciliaris* (buffel grass) failed to establish properly when attempted over large areas. Pangola grass was once the most promising introduction but the virus stunting disease of pangola grass which causes diminished growth, short internodes and patches of dead grass in the field as described by Dirven and Van Hoff (1960) has resulted in the phasing out of pangola in the region (Hunker *et al*, 1972). *Digitara pentzii* (Transvala digit grass) was found to be resistant to this disease (Holder and Latchman, 1970) and in grazing trials with pangola was not observed to be significantly different in production parameters (Holder and Edwards, 1972).

Work on the genus *Digitaria* has been stressed because of its high palatability, proven adaptation and production under conditions prevailing in the Intermediate Savannahs. However, the high fertiliser requirements needed for optimal grass growth in the area has led researchers to look for alternate, less demanding species. To this end guinea grass and tanner grass are being grown extensively at the Ebini Research Station under a minimal fertiliser regime, with some considerable success.

Legumes have been introduced into the region both on improved and unimproved savannah land with a view to (a) maintaining adequate protein and digestibility levels during dry periods and (b) eliminating if possible, the use of nitrogenous fertilisers. Phosphates, however, are still necessary for legume establishment and survival in pasture swards. Legumes introduced in pastures at the Ebini Station are *Calapogonium mucunoides* (calapo), *Stylosanthes guyanensis* (stylo), varieties endeavour and schofield, *Phaseolus macroptilium* (siratro), *Indigofera hirsuta* (hairy indigo) and *Centrosema pubescens* (centro). Of these centro has been the least successful probably due to the high specificity of its rhizobia and greater nitrogen requirements for establishment than the poor sandy soils of the savannahs can offer. Table 1 shows data relating to the growth of heifers on grass legume pastures (Transvala) *vis-a-vis* pastures fertilised with varying levels of urea (Holder, 1974). With the exception of centro, legumes appear to be providing the equivalent of between 200 and 400 pounds urea per acre. Of more importance is the fact that growth rates in young animals remained much more constant during wet and dry seasons in legume association than in pure grass swards.

Legumes have been incorporated into the savannah vegetation with limited success. Although reasonable to good establishment has been achieved with stylo and siratro, the establishment of centro proved problematic. Table 2 shows production data obtained with weaner bulls on native pastures with and without legumes. It can be observed that carrying capacity was consistently improved and growth rates much better on grass/legume swards.

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[1] Based on taxonomic, morphological, chromosome number and embryo sac development data the following USDA P.I.'s share the same cultivar name 'Transvala': 299601, 299752, 299837 and 364619. The accessions 299752 and 299837 were reclassified as *D. decumbens* the same as 299601 by Dr. Decker of Ohio, Wesleyan University, Delaware.

Table 1. Comparative Performance of Weaner Heifers on Transvala Digit Grass Pastures Fertilised with Nitrogen and in association with Legumes

Treatment	Average Daily Gain per Heifer (lb.)
Pasture (0 urea 200 TSP*)	0.63
Pasture (200 urea 200 TSP)	0.95
Pasture (400 urea 200 TSP)	1.45
Pasture/centro (200 TSP)	0.85
Pasture/siratro (200 TSP)	1.01
Pasture/stylo (200 TSP)	1.24

Table 2. Performance of Weaner Bulls on Native Savannah in association with Stylo Endeavour

	Av. Daily Gain (lb.)	Stocking Rate (acre per animal)
Native savannah land	0.13	15
Savannah + stylo (200 lb. TSP/acre)	0.48**	10
Savannah + stylo (100 TSP/acre)	0.52**	10

Table 3. Cow Herd Performance on Four Pasture Management Programmes

Pasture Programme	Adult Weight (lb)	Calving Percentage (%)	Calf Mortality (%)	Weaning[a] Weight (lb)
Improved pastures	800	73	5	350
Improved & legume[b]	894	88	7	395
Native savannah	684	35	25	350
Native savannah and legumes[b]	737	65	15	309

Notes: * TSP = Triple Superphosphate
** Difference not significant
a One year data on calves
b Stylo (endeavour)

Table 3 shows cow herd production on various pasture programmes. Here again the superiority of legume associations can be observed. (Legumes used were calapo and stylo on improved pastures and stylo, siratro and centro on native pastures. Herd sizes were 60 females on each treatment.) The management of legumes in native grass swards on the intermediate savannahs does merit some consideration. When planted among native grasses the tendency is heavy competition with savannah grass threatening plant survival - due largely to the animals' preference for the legume and the exclusion of other species. Some success has been obtained when legumes are planted in strips in which the native grasses have been eliminated. A similar technique might encourage associations of legumes with tanner and guinea grasses two very vigorous species which have so far resisted associations under conditions prevailing at Ebini.

Forested Savannah Land: Pasture production under forested brown sand savannah land is currently being attempted at Moblissa for purposes of dairy production. Transvala, pangola, tanner, antelope and guinea grasses are being planted in pure stands and in association with stylo, indigo and calapo. The forest has been hand-felled and the remaining stumps are being removed by heavy machines.

Pastures have been established on both stumped and unstumped land. Grass production so far has been extremely encouraging with excellent establishment with the addition of little or no fertiliser. The project is currently in its infancy with only a few hundred acres under cultivation out of a scheduled 3,000. Of particular interest is the establishment of legumes (particularly *Indigofera*, endeavour and schofield stylos with minimal applications of phosphate suggesting some superiority of forested savannah land over natural grassland in the area.

On the Intermediate Savannahs in general one major weed species is *Sporobolus indicus* (iron or smut grass). Once established it is extremely difficult to erradicate as erradication involves heavy discing during dry spells to expose the roots to dessication (this usually results in replanting the original grass sward) or the use of 'dalapon' in association with heavy nitrogenous fertiliser applications so permitting complete dominance of the planted grass in the sward.

Crotalari spectabilis is a leguminous weed which has been suspected of causing liver damage in ruminant animals through the action of monocrotaline which it harbours in its leaves. Slashing of pastures by mowers eliminates this species rather easily.

Overgrazing of pastures on the sandy soils of the Intermediate Savannahs is relatively easy to accomplish particularly during dry periods. The presence of the naturalised legume *Desmodium triflorum* is often a sure sign of too high a stocking rate or too heavy a grazing pressure. No easy guidelines can be given with regards to stocking rate and number of pastures in the rotation system since this is largely dependent on type of forage species and soil type. Ratational grazing is almost mandatory on improved swards if optimal utilisation is to be achieved, especially in view of the high costs of fertilisers.

The North West Region

Pasture vegetation: The North West Region of Guyana in its

natural state comprises dense tropical rain forest jungle with little if any natural grassland vegetation. Pasture establishment follows hand or machine clearing and the extremely high rainfall (about 110 inches annually) permits pasture establishment almost on a year round basis despite an essentially bimodal rainfall distribution.

Pasture grasses introduced into the area at the Government livestock station at Arakaka (and to a lesser extent Pakera) in the Matthew's Ridge area include pangola grass, transvala digit grass, guinea grass (variety Hamil) and setaria. *Ischaemum timorens* (locuntu) is also found to some extent in the area. Tanner grass is a species demonstrating excellent promise in the area.

Legumes chosen for pasture studies are stylo, centro, greenleaf desmodium *(Desmodium intortum)* and galapo. Triple superphosphate at a rate of 56 pounds per acre appears to be a level of fertilisation satisfactory for all combinations.

During very wet periods (long wet season) there is often a tendency for streams and rivers in the area to overflow their banks causing heavy inundation of planted pastures. This along with compaction resulting from the use of heavy machine for land clearing during unfavourable weather conditions permits heavy ingressions of sedges which readily compete (occasionally successfully) with pasture grasses - particularly *Digitaria* strains. Tanner grass has been found, however, to compete satisfactorily showing vigorous growth under these waterlogged conditions.

Mismanagement of pastures can permit heavy ingressions of razor grass which seems to be a pioneer species in the area. It is therefore critical that land once cleared should be planted with dispatch.

Animal production data: Although research is still in its infancy animal production data on the current pasture/legume programmes are quite promising. Conception rates in beef herds are in the vicinity of 70 per cent annually and liveweight gain of weaners on pasture/legume swards grazed on a rotational basis is in the vicinity of one pound per animal per day.

The Rupununi Savannahs

Natural vegetation: The natural vegetation of the Rupununi is in some respects similar to that of the Intermediate Savannahs the dominant species being *Trachypogon plumosus* in association with *Andropogon leucostachyus* and occasionally the species in the genus *Mesosetum*. Guinea grass is found naturally in the foothills of the mountains which are essentially loamy sands much more fertile than the rather poor sandy and leteritic savannah soils. *Aristida* sp. is found in the more sandy areas on the savannah. Indigenous and naturalised leguminous species found in the area include *Stylosanthes angustifolia*, *stylo viscaso* and *stylo gracilis* in the drier areas. Species of *Cassia* and *crotalaria* have also been observed. On the lower lying savannah areas - which are completely inundated during the single annual wet season (May to September) the sedge *Rhynospera* sp. is quite prolific.

Improved pastures: Improved pastures are virtually unknown in the Rupununi savannahs since the harsh climatic pattern of 60 inches

of rain falling over a five-month period with drought conditions for seven months prevailing thereafter has proven in the past a somewhat insurmountable problem, moreso when any fertilisers which might be necessary for pasture establishment and maintenance will have to be air freighted into the area at considerable expense. However, in recent times attempts have been made to establish - albeit on a small scale - pasture grasses of low fertility requirements. Limited success has so far been achieved with molasses grass on the higher areas and tanner grass, antelope grass and strains of para grass *(Brachiaria mutica)* in the more low lying areas of the savannahs. Pangola grass has been established in small isolated areas on the savannahs usually with some initial fertiliser applications and the fact it has managed to persist for a number of years is quite encouraging.

Stylo humilis (townsville stylo) was attempted as an introduction in the Rupununi but although germination was excellent the plant grew to a height of 3 to 4 inches, matured and set seed thus contributing little to total dry matter production. The factors thought responsible for the poor performance were (a) the dry season in the Rupununi is not quite dry enough to get maximum benefit from an annual legume in a pasture grazing situation, (b) the low fertility of the soil, and (c) the fact that the short day length of the area might be upsetting the photo period of this annual stylo. New investigations have commenced using stylo endeavour (a perennial) and so far this appears to be a more promising strain.

Pasture management: Burning is an extremely common practice in the Rupununi savannahs during the dry season - unfortunately it is seldom controlled for animal production purposes. Animals however do capitalise on the higher digestibility and protein contents of the new growth of *Trachypogon* and this helps to sustain animal weights or at least minimise the liveweight decline during the dry season. Considering the stocking rate of the area at an animal to 60 acres selectivity of grazing is practised to some considerable extent by ruminants. Under current minimal management, conception rates are seldom over 50 per cent in the cow herds and is usually much lower and weaner animals take between 3 and 7 years to achieve suitable marketable weights. A range which is quite untenable for general management purposes.

The hope for improved Rupununi grasslands lies in (a) controlling *indiscriminate* burning of the natural grass sward and (b) selection of adapted improved grasses and legumes capable of retaining moisture during the dry seasons by an extensive vegetative cover and increasing soil organic matter content so changing the extremely sandy and infertile savannah conditions for more profitable use. This has been achieved under improved grassland conditions on the Intermediate Savannahs. The presence of grasses/legumes of higher nutrient content will also tend to increase cow herd production and shorten considerably the long period between birth and market. Improved forages will also encourage increased carrying capacity on the savannahs compared to the present low levels.

General Problems of Pasture Management

The main effect of climate and associated seasonal changes is the low quantity of feed available for ruminant livestock. The most important climatic factors that limit plant growth and hence the quantity of feed available are temperature, active precipitation, length of daylight and the intensity of solar radiation. In the humid tropics forage growth is continuous and very rapid though still seasonal and very high annual yields

may be obtained. It is logical to expect that forage grown under conditions of abundant rainfall and high humidity should contain a higher water content and many studies show this. Payne suggests that the inability of the ruminant animal grazing humid tropical forage to obtain a sufficiently high dry matter intake is often caused by high water content of (low DM) or the free water on the ingested fodder. Experimental evidence by Butterworth, Groom and Wilson (1961) shows that the amount of feed DM consumed is affected by the water content of forage.

The seasonal changes in forage quality and quantity are reflected in seasonal changes in the liveweight performance of cattle, and this is illustrated in Figure 5 which shows the experiences obtained at Ebini on the Intermediate Savannahs when cattle were exposed to four pasture management programmes - weight gains in cow herds during wet seasons and losses during the dry periods. However, there is one peculiarity of liveweight loss in tropical areas that is the particular interest, the 'green grass loss'. This is a loss in liveweight experienced by cattle at the beginning of the 'rainy' season. After the onset of the rains and the growth of fresh, green grass, cattle continue to lose weight. Payne (1965) reported that 60 per cent of the seasonal loss of body weight experienced by cattle in Tanzania took place during the first three weeks after the onset of the rains, and that it was 11 or 12 weeks before the liveweight of cattle recovered to what it was before the rains. French (1956) also observed this in East Africa. Blue and Tergas (1969) noted that in the wet/dry tropical areas of Costa Rica weight losses among all classes of cattle which were large during the dry season, continued into the early part of the rainy season *"because of scouring which is caused by lush young grass"*.

This loss in the liveweight in cattle early in the wet season has also been observed by Holder (1972) at Ebini on the Intermediate Savannahs where pangola grass samples were harvested from set stocked pastures over wet and dry seasons at 28 day intervals and analysed for crude protein, IVOMD and lignin. Figure 6 shows graphically the data obtained from laboratory analysis. According to Clarke (1938) cell walls are continuously interpenetrating systems of cellulose and lignin with progressive lignification paralleling advancing maturity or being stimulated by adverse climatic conditions. Crampton and Maynard (1938) and Crampton and Forshaw (1939) have observed that the reductions in the digestibility of cell wall organic nutrients and in the available herbage are correlated with the degree of lignification so that the mode of distribution as well as the quantity of lignin affect digestibility and nutritive values.

In Figure 6 the periods of lowest rainfall were periods 6 and 7 corresponding with the latter portion of the short dry season. The observed decline in digestibility and increase in lignin content commenced during the 7th period reaching the highest and lowest points respectively, during the 8th period. (The 7th and 8th periods correspond to the onset of the rainy season.) A depression in animal weight gains was observed during these periods, picking up again in the 9th. The correlation coefficient between IVOMD and lignin was -0.9 which was highly significant. It is possible that wilting of forages during the dry season with corresponding effects extending into the early part of the wet season may be responsible for the *"green grass loss"* which has been observed by Payne (1965), French (1956) and Blue and Tergas

Figure 7. Ebini Livestock Research Station: Number of Calves Born Monthly (1958-1968) on a Year-round Breeding Programme.

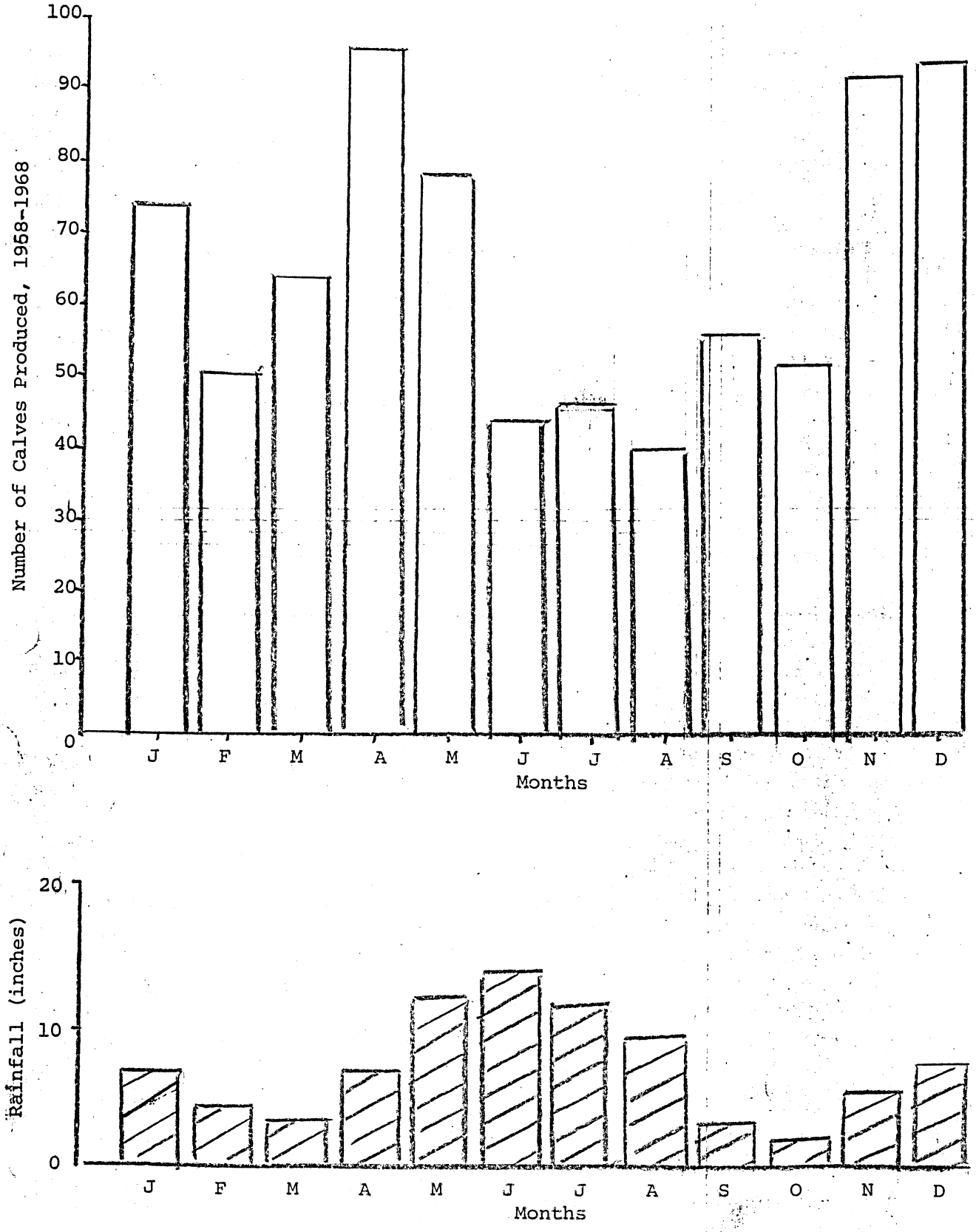


Figure 5. Seasonal Changes in Liveweight of the Ebini Beef Herd on Four Pasture Management Programmes.

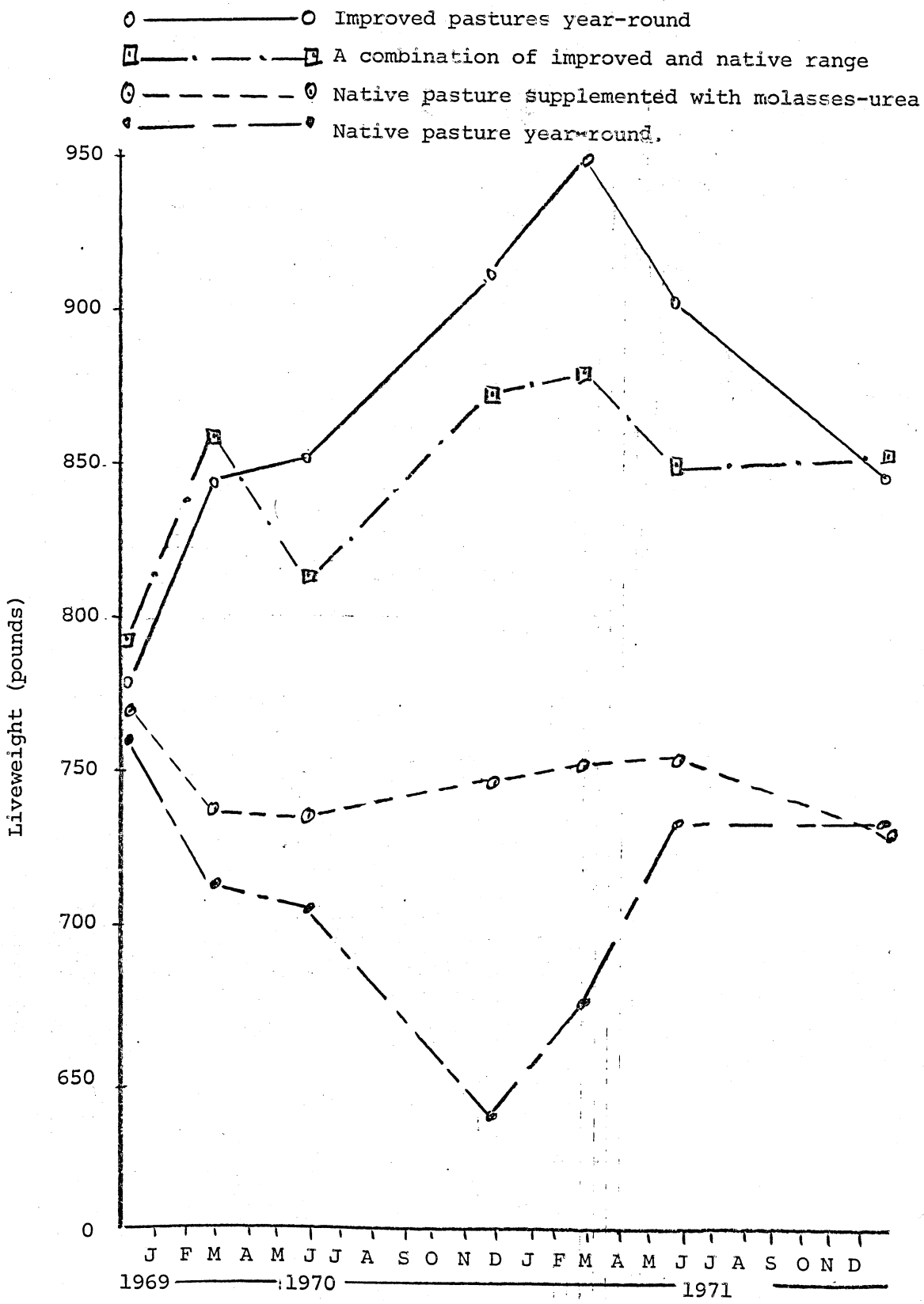
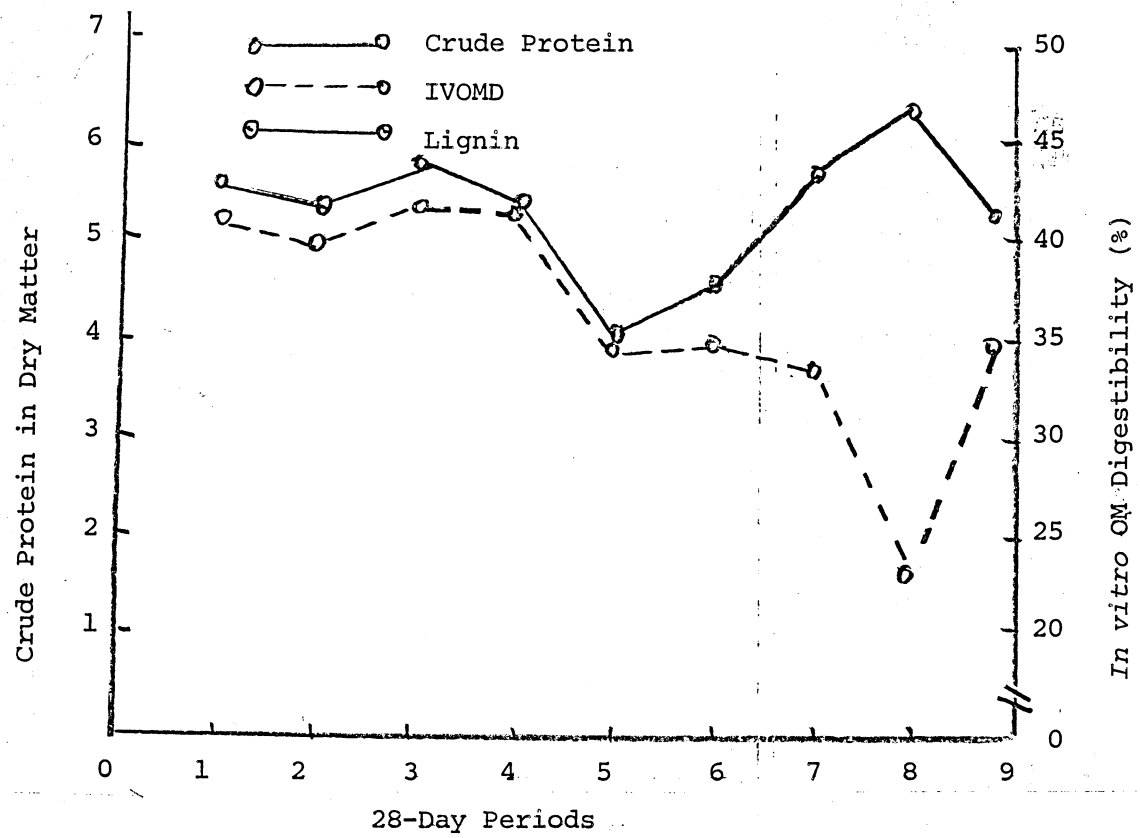
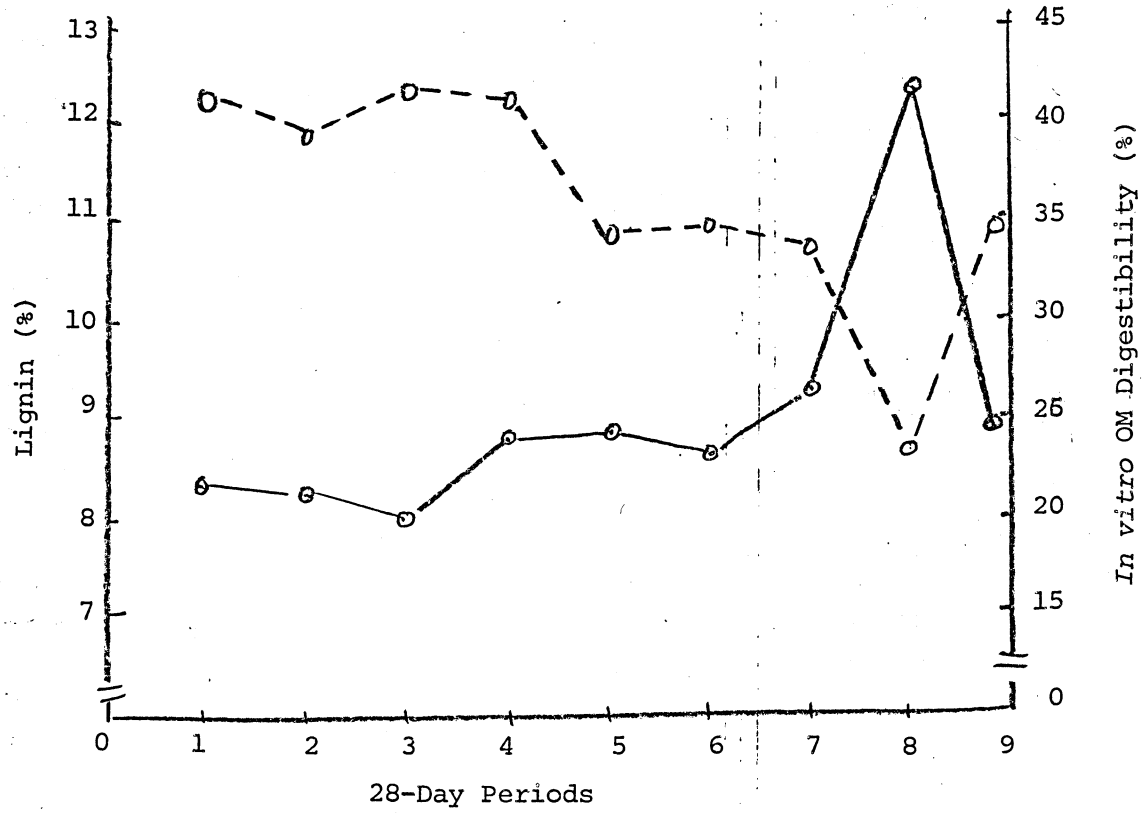


Figure 6. (a) Relationship between Crude Protein and *in vitro* Organic Matter Digestibility.



(b) Relationship between Lignin Content and *in vitro* Organic Matter Digestibility.



(1969). The increase in protein content during periods 7 and 8 probably tallies with the increase in lignin since crude protein is essentially N x 6.25 and Nitrogen is readily stored in the ligno-cellulose complex in the plant.

Possible Solutions

Seasonal production system: Figure 7 shows the number of calves born monthly on a year-round breeding programme at Ebini over a ten year period. It can be observed that there were two peaks of calving, April (30 per cent) and November-December (32 per cent) (Holder, 1969). However, calves born during the April peak suffered higher mortality than those born in November-December perhaps due to the ravages of the long wet season (April-August). It should be noted from the data that most cows therefore, come into "heat" during the latter portion of the rainy season. Controlling the breeding season to permit calving in the latter part of the year at Ebini has resulted in an increase in calving rate (70 per cent) a diminution in mortality (to 7 per cent) improved and more even liveweight gains in weaner animals and much better pasture utilisation since finishers come off pastures during the peak of the rains and are replaced thereon by weaners at the start of the subsequent dry season - so effectively maintaining a constant stocking rate in spite of changes in the quantity of forage on offer. Weaning at 7 to 9 months also ensures that animals are carrying their young only during periods when forage is plentiful, thus they are free of their charges during the long dry season so reducing stress on themselves. This technique is currently being tried at Arakaka in the North West region with success. It is possible that with some modification it can be adapted to conditions prevailing in the Rupununi As a technique it does have obvious limitations if considered for dairy cattle since milk production on a year-round basis is desirable.

Forage conservation: Forage conservation methods have been briefly discussed previously, both hay and/or silage-making during periods of maximum growth are distinct possibilities.

Legume grass associations: These can be expanded to maintain forage quality during wet and dry seasons so reducing liveweight fluctuations.

Irrigation: This is a distinct possibility in dairy herds so maintaining forage growth on a year round basis. In view of the high water content of forages during the wet season it might be possible to make hay on irrigated pastures during dry periods and feed back to livestock during wet seasons so hopefully eliminating the "green grass loss" and increasing dry matter intake.

Supplemental feeding: This is also a distinct possibility tried with success at both Ebini and Matthews Ridge where concentrates make up for forage deficiencies both in quantity and in quality during wet and dry seasons (Holder and Edwards, 1972; Holder, 1972). The use of corn silage is currently being tried at Ebini and trials with comfith with and without cane tops and urea should commence at Arakaka during the course of this year.

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