SOME PROBLEMS OF PASTURE MANAGEMENT IN THE DEVELOPMENT OF THE LIVESTOCK INDUSTRY IN JAMAICA

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Introduction

Only about one-seventh of the surface area of Jamaica can be considered as flat. The principal mountain ridges run essentially in an east-west direction, roughly in the centre of the island; and the rivers exit to the sea either towards the north or towards the south. The main areas of flat lands are on the southern section of the island and from east to west are the Liguanea plains on which Kingston is situated, the St. Catherine plains, the plains of Vere in Clarendon, the Pedro plains and Upper Morass area in St. Elizabeth and the savannas and Great Georges Plain in Westmoreland. There are scattered areas of tractable land located elsewhere especially in the upland region of Manchester, and on the northern plateau and coastal areas from about the middle of the island in St. Anns westward towards Montego Bay. As the trade winds are north-easterly the areas of greatest precipation are towards the eastern end of the island, and along the mountain ridges. Thus, a great deal of tractable land lies in the rain shadow and water for agriculture is supplied either from rivers or from underground sources.

Based on a recent survey (Motta, 1975) the total average land now available in Jamaica for agricultural use is estimated at 1.5 million acres. About one-third of this (500,000 acres) area is utilized for grassland production at varying levels of productivity. One-half of the grassland is estimated to be in improved pastures, one-third in unimproved pastures, and the remainder in ruinate, marginal and submarginal terrain used for extensive grazing and management systems. Within the pasture framework exists a livestock industry consisting of an estimated 146,000 animal units of beef (ca. 250,000 animals) and 46,000 animal units of dairy (ca. 57,000 animals) an an unspecified number of sheep, goats and other stocks.

The problems of pasture management will therefore be discussed against the background of existing pasture acreages and animal population, and some projected targets of animal population and production for the future. Projected estimates for milk and beef sufficiency for 1980 indicated the need to maintain a milking herd of 80,000 cows plus followers (calves, heifers ca. 85,000) on 150,000 acres of land; and a beef population of about 120,000 breeding cows with calves plus followers (yearlings, animals for feedlot etc. ca. 140,000) on 301,000 acres of land. This population increase is estimated to lift the milk production from the present 38-40 million quarts per year to about 120 million quarts per year in 1980-81, and beef from approximately 27 to 39 million pounds. In 1980-81 the total animal units from milk and beef is estimated at 316,000 held on 450,000 acres of land. The remaining 50,000 acres will be allocated to sheep, goats and other stocks grazed chiefly on ruinate, rocky, marginal and submarginal lands. The major problems will therefore be those which require solutions leading to an increase in the carrying capacity of pastures against the background of land limitation, and to those leading to possible readjustment in farming patterns with an emphasis on concentrating the livestock enterprise into specific locations. In other words the projected plan aims at doubling the cattle population without any increase in land area, and at the same time increasing the efficiency of animal output from available land resources.

Traditional Livestock Industry in Jamaica

Historically in Jamaica a livestock industry principally of cattle has been based on a system of feed provision from guinea grass *(Panicum maximum)* on the plains, and 'common grasses' chiefly crab and carpet grasses in the hills. The traditional export of sugar cane, bananas, citrus and cocoa dominated most of the best lands on the plains and other areas, which had irrigation facilities or adequate rainfall. Pastures were established on the *left over* from these areas especially on lands of poor soil types. Until quite recently a cattle enterprise on lands considered tractable was symptomatic of either very poor soils (saline clay) where water was available, or alternately, where the soil type was adequate, rainfall was the limiting factor to other economic alternatives, and the area impossible to irrigate. Pastures were allowed only under such conditions with their output related to seasonal rainfall and stocking pressures. Supplementary feed for stocks especially over the winter months was provided by making silage from uba cane *(Saccharum officinarum)* and by feeding cane tops and/or molasses. The carrying capacity of pastures was related to available feed, and in most instances stocks would be reduced in the incidence of severe drought. This system of feed provision was associated with low levels of animal productivity with the accent on beef and some draft type animals, and milk as a secondary product. There was between 0.6 to 0.8 animal units per acre, and livestock gains of 280 pounds per year was considered adequate. A loose system of rotational grazing and set stocking was practised on whatever grass predominated.

Against this background of stock and pasture, the decision was taken in the early 1940's to introduce grasses such as the pennicetum strains - napier, elephant, Uganda - and this prompted research into increasing fodder production for an improved animal industry. The original investigatory work dealt mainly with responses of certain grass species to fertilizer application. Improvements in fertilizer application stimulated grass yields which in turn stimulated greater numbers of cattle. At the same time improvements in the type of cattle were taking place with some shift of emphasis from meat to milk. The investigatory and grass introduction work was expanded in the early 1950's with the primary objective of meeting nutrient requirements of livestock from improved pastures. Notably among the introductions was pangola grass *(Digitaria decumbens* Stent) which is now widely distributed, and is the main grass species on which the animal industry rests. The grasses now in current use in Jamaica are pangola grass, coastal bermuda, para grass, *Bracharia decumbens,* and some cutting grasses like napier. These are used in a variety of management systems which range from zero to full rotational grazing, and which now support a population estimated at 192,000 animal units on half million acres of land.

The major concern of the pasture complex in Jamaica is therefore basically one of intensification especially within the dairy enterprise, and is related to factors which include the location of the industry (present and proposed), ecology, managerial skills and input of the farmer, fodder conservation, grass species, grass management practices, research, finance and technological 'know how' and those factors related to Agency policies. Attempts at possible solutions in a Jamaican context will be advanced in a discussion of these problems.

Siting of the Industry

The beef cattle industry is confined largely to the sugar estates, on the bauxite lands, and to those areas along the northern plateau from about the centre of the island westwards. Because of factors such as soil type, rainfall, topography and patterns of land ownership etc. the industry is in varying stages of intensification and occupies more than 60 per cent of the pasture lands. In 1972 the local production of beef was estimated at 26 million pounds. Excluding tinned and corned beef an additional 8.3 million pounds of chilled and frozen beef was imported. These figures imply that national self-sufficiency in beef is within reach with some amount of intensification of lands now occupied with beef cattle. Recommendations for immediate improvements include bushing of pastures, establishing good stands of improved grasses and maintaining good ground cover, improving drinking water supply at pasture, and increasing fertilizer application either by using inorganic fertilizer or in such forms as poultry litter and recycled waste. It is estimated that an increase in fertilizer application alone can bring about vast improvements in the forage on offer. Feeding systems can be arranged, utilizing either full feed-lot fattening or some type of restrictive or back grazing procedures in order to reduce stocking pressures on pastures especially during times of feed scarcity. However, proper costing is necessary in order to establish realistic economics as stagnation in intensification is likely to occur if the beef enterprise is not profitable.

The dairy industry has by tradition been more scattered, and covers the range from small and medium size farms in the hills to the large specialized farms on the plains. This wide scatter of farms and variations in size and levels of efficiency has involved long uneconomic milk routes, and longer quarrels about the cost and price of milk. However, since the policy at the moment is to intensify the livestock industry, this has necessitated a shift which is polarising the dairy enterprise into clearly defined locations. Already four such areas have been identified. These are the Serge Island area in the east end of the island which will supply milk to Kingston, the Clarendon/St. Catherine area in the centre to supply May Pen and Spanish Town, the Cornwall Dairy area at Montpelier to supply Montego Bay area, and Shaw Park in the north to supply the Ocho Rios area.

Relocations of this nature has several advantages. By locating these areas around centres of population, transport and other infrastructural adequacy, and by increasing the scale of operation, the gross effect will be a tendency to stabilize the price of milk. Problems of feed provision and pasture management will be concentrated into defined areas and in more precise terms. Some specific problems such as related to soil type, moisture availability, drainage, traditional farming patterns within each area etc. will arise, but the main problem is the manipulation of these areas to feed a more intense animal population. This requires specialist approach and specialist activities. As the cattle population increases so as the demand for fodder which must either be produced within each area or brought into it. Within each area are micro environments supporting good grass growth, and which are the traditional suppliers of grass during the dry season. Better cultural practices must be employed to support such good stands, and specialist activity should be directed to the growth, storage and sale of fodder chiefly as hay from such areas. Therefore, in addition to pastures, a feed support system located within, or in close proximity to, the dairy complex is essential. Apart from hay, this should consist of silage made preferably from corn or sorghum in order to partially satisfy the energy deficit from grass. In the hilly regions surrounding an area, the use of uba cane and other high yielding grasses should be encouraged. Uba cane is high yielding, contributes both bulk and energy, and can be fed as green chop or as silage during periods of drought.

Ecological Factors

The relationship of the grass specie to its environment in terms of its adaptibility to climate, soil and water is an important determinant of the total forage supply available from pasture for intensive animal production. It is therefore important to have different species of grass adapted to different ecological conditions, or conversely, to adapt or alter where possible those aspects of environment that limit production. In Jamaica some amount of adaptation has already taken place, e.g. guinea grass is largely confined to the coastal regions, coastal bermuda to the drier areas and para grass to some poorly drained areas. Pangola grass is distributed almost everywhere and on nearly every type of soil.

Climate

Because of the microclimatic variations in Jamaica it is difficult for one or two grass species to adapt by and large, and this constitutes a problem where livestock production is based on too few grass species. Temperature exerts pronounced effects, e.g. pangola grass becomes dormant in areas of low night temperatures, especially during winter, when night temperatures fall in the region of 56-60^{o}F. Growth stagnates and forage supply from pastures becomes a problem at this time. Furthermore, there is no selection in Jamaica at this moment for a grass that will grow at such low night temperatures, hence the need for a selection biased for winter growth. One possible solution lies with the kikiyu grass, but it is rhyzomatious; difficult to eradicate and well nigh disastrous in a mixed crop economy. Perhaps it may be useful in areas that are left permanently in grass. In addition to a 'winter grass' there is also the need for multigrass species, and other complementary systems of feed provision, especially to ensure an adequate supply of good quality fodder throughout the year. To this end some effort, perhaps on a regional basis, should be directed; at the selection of at least two suitable grass species for use in the pasture systems of the region.

Soil

Apart from the bauxite lands which possess similar types of soil throughout, there is such soil type variations in Jamaica as to make it virtually impossible to conduct experiments relating types of grass to soil. Some work of this nature must however be undertaken, especially in areas of present or future livestock concentration. As mentioned previously most of the better lands with irrigation or high rainfall are devoted to export agriculture, and therefore guinea grass, which is both high yielding and naturally adapted to those areas, is confined to locations subjected to salinity or prone to water logging. Solution to this problem lies in the introduction of adequate drainage facilities, and in those practices such as liming and application of organic fertilizer etc. which improve soil structure. Nearly all the irrigation facilities established on the plains have been laid down without parallel drainage systems. In addition to this the practice of flood irrigation further compounds the drainage problem on these poor clay soils. Therefore, in addition to drainage systems a shift in water use appears necessary, e.g. one leading to the overhead sprinkler type of water application. There is also the need to drain hitherto unreclaimed swamps such as the Upper Morass in St. Elizabeth which alone estimated could increase available land by some 8,000 acres. Part of this land could be used for specialized fodder production.

Water

Despite the fact that the Arawak name for the island XAYMACA means *"land of wood and water"* one of the main deterrents to agricultural production in the country is the lack of water. Outside of the areas of high precipitation, water for agriculture comes from either irrigation and/or seasonal rainfall. Until quite recently, irrigation has been oriented around export agriculture, but new crops including grasses are rapidly being brought within its scope. At the moment costly governmental schemes are underway to provide water, but priorities appear directed towards provision of domestic supply. Therefore the lack of water limits forage and other agricultural production over several months of the year, especially on the slopes and in the rain shadow areas.

Because of this lack of water there are many areas of good land under semi-intensive and extensive grazing systems. Good stands of grass appear over several months of the year, but for the remaining months the pastures are dry. There is a tendency, however, to underestimate the ability of these dry pastures to maintain animals. The problem is due mostly to a lack of drinking water rather than to lack of dry matter. Therefore greater attention must be devoted to water storage in these areas. In some of these locations (e.g. the northern part of West St. Catherine plains) the introduction of more inland wells only serve to increase the salinity of lands nearer to the sea. Farming pattern is therefore of a mixed nature, organized around seasonal rainfall and consists principally of small farms. In these types of environments and in the hills, the use of a high producing, drought-resistant, stoloniferous grass is essential, with the complementary system of a standing grass like uba cane or napier. There is also the need for farming to be readjusted in these areas with a shift in the pattern of livestock husbandry. This shift should be directed from an emphasis on milk production, to one firstly of a cow and calf operation aimed at meeting family requirements, and secondly and more fundamentally, to one of specialized calf and heifer rearing, designed to support a dairying enterprise in the more concentrated areas.

This shift away from milk for processing by the small farmer to straight liquid for calves and family consumption is considered important, in that specialist expertise can be developed and applied in the rearing of replacement calves. Calf mortality would be reduced, techniques like multiple sucking introduced, dairy bulls, sheep and goats can be reared, and a system can be developed which releases the specialist milk producer on the plains from the onus of calf rearing to one of milking at full capacity. Incentive programmes can be introduced to encourage this development on both sides, and should be of great advantage to the small farmer who has less infrastructural facilities at hand, and tends to be less efficient.

Farmer Efficiency

Farmer efficiency in grassland husbandry relates to the level of his input in such terms as managerial skills, knowledge and finance. In many instances in Jamaica, even with proper grass varieties, some farmers would still be no better off, because of poor management; and the clamour for new varieties in some quarter is a statement of continuing mismanagement. Most of the improved pastures were established nearly 20 years ago, and are now in need of renovation. After a few years diminishing returns set in, and many of these pastures are now operating below 50 per cent efficiency irrespective of water availability. The effects of overstocking, compaction, poor grass cover etc., have resulted in weed infestation and 'take over' by such grasses as Seymour *(Andropogen pertusus)* on some farms especially on the plains. There is thus the present and urgent need to resuscitate pastures by reploughing and in some areas replanting; as also the need to establish a resuscitation programme at least every 5 to 6 years, perhaps through the medium of grass/nurse crop combinations. In areas where guinea grass predominates there is the need to seed down the grass once in a while in order to maintain a good stand, and to prevent the take over by Seymour grass.

Apart from efficient herd management there is a need to manage pastures for quality fodder as well as for quantity in order to minimise the use of concentrate. It is therefore necessary to have some knowledge of the nature of the grass in its growth habit, nutritive value, fertilizer and water requirements etc. and also its limitations. Particular knowledge can be acquired through specialist contact with the agencies that service livestock, and an emphasis should be placed on in-depth training especially farm training. Specifically there is the need to develop an awareness for an increase in fertilizer application from a national level of 2.5 to 3 cwt. per year to some higher figure in order to exploit full fodder potential from lands now in pasture. Research data available in the region indicate that forage production can be substantially increased by a judicious increase in fertilizer alone, and this is the salient feature around which an increase in livestock production will be based.

There is also the necessity to recycle organic manure in order to reduce fertilizer cost and improve soil fertility. There must be some proper understanding of changes in grass quality in order to allocate supplements and concentrate in a more meaningful manner. Pastures, where they are to be subdivided, must be subdivided in such a manner as to be a management aid. The size and number of pastures must bear some relation to the growth habit of the grass so that at each point in a rotation cycle, animals will return to grass of sufficient quantity and at the peak of the nutritive value for that time of the year. It is essential to develop the proper attitude for the type of work involved in the livestock enterprise, and absentee ownership must be replaced by on the spot operators.

Coupled with farmer 'know how' and managerial skills, is the availability of agricultural credit and realistic financing. This greatly affects farm income, and the ability of the farmer to repay his debt and earn a living. Credit availability is insufficient in many instances but quite recently the programmes of the Jamaica Development Bank and the Credit Board have been sufficiently intensified to assist with supervised credit. The idea of agriculture being a low capital industry therefore appears quite misleading, and proper financing is needed to exploit agricultural potential. However, one of the problems confronting farming is the lack of such managerial research as to give sufficient indications of how to get the most out of spending. For example, the money spent on fertilizer is known to improve the output of fodder, but it is quite likely that similar results could be achieved with less money spent on fertilizer if the proper combinations with other factors were known. One practical example of poor spending in Jamaica is the substitution of imported concentrate feed (and foreign exchange) for grass and grass-based products; hence placing the emphasis on buying rather than producing feed for cattle. In short the whole question of husbandry and managerial research appears to be an area worthy of a problem-oriented approach within the region.

Fodder Conservation

Fodder conservation - a wide subject in itself- assumes importance in Jamaica because of:- (i) the projected doubling of the animal population within the next six years without any increase inland; (ii) concentrating the dairy cattle enterprise into specific areas; and (iii) the need to reduce the emphasis and reliance on concentrates. The demand for a large concentrated animal population for fodder increases firstly the need to obtain high yields from well managed grasses, and secondly the need to conserve and to preserve as hay and silage such feed as is required to satisfy the animal feed requirements. The projected requirement of concentrate in 1980-81 is 15,000 tons above present locally available supplies of about 40,000 tons. To supply this feed in the form of conserved fodder would require about 3,000 acres of land producing 10 tons of dry matter per acre per year. In arriving at the acreage it is assumed that the feeding value of hay is about half that of concentrate. In order to achieve this target a programme of hay and silage making is warranted within and around areas of cattle concentration, and in those localities supporting good stands of grass. There will, however, be some problems of technology to overcome, such as securing suitable equipment, maintenance and so on. About 25 per cent of the land area can be mechanised, but the design and type of equipment on offer is not always suitable for the terrain. It is important that the making of hay and silage be related to specialist activities in order to maximize production from the land in and around the dairy complex. This will increase the carrying capacity of the dairy complex perhaps twofold, the milking operations can be sited on less productive lands, and fed can be stored against emergencies and transported over long distances if necessary. On the slopes the need arises for small mechanized, perhaps hand driven units, which can manage the terrain and are useful in cutting and hauling forage. The use of new materials, for example, comfith for dairy and beef should be explored, and the time appears appropriate to begin thinking in terms of grass drying operations within the region.

The need to conserve is also dictated by the necessity to move towards the maximum utilization of grass, as the first step towards economic animal production. When properly fertilized and well managed, there are improved grass species that can provide most, if not all, of the crude protein required to sustain high levels of production. However, grass and grass products will not furnish all the energy requirements for some functions such as high milk production among breeds of cattle such as the Holsteins and Jamaica Hope. Therefore to partially compensate for this, a system of sorghum or corn silage must be developed, as the energy concentration of these feeds is greater than that of grass. Nevertheless the energy output from fodder in general is much less than that from concentration, and this in part accounts for the failure to achieve rates of animal productivity in these parts compared to those obtained in temperate regions. However, because of the greater efficiency of dry matter production in the tropics, greater emphasis should be placed on an increased animal population, such that while the output per animal would be moderate, the output per unit area would be high. In other words the total weight gains of beef cattle per acre per year, rather than their rate of growth, and output of milk per acre rather than production per animal should be stressed.

Therefore to maintain the number of animals for national sufficiency in milk and beef, such intensification of feed production is required, as to warrant immediate specialization and centralization of all functions relating to conservation. The venture of the forage farm must, however, be a profitable one. The farm should be in close proximity to the dairy complex, and should incorporate in its management such features as the Specialist Manager, and such practices as the application of liquid manure from the dairy complex on the pastures.

Research

Over the past two or three decades the input or research has been biased towards species selection, agronomic investigations and forage evaluations based principally on weight gains in cattle. Resulting from these efforts are the grass selections already mentioned, and a system of husbandry practices put to use on the more progressive farms. Apart from current grasses the present and future status of the livestock industry warrant the need for new introductions. There is the need as indicate substantial variations in the nutritive value of the grass throughout the year. Some yields of dry matter, crude protein and digestible crude protein are given in Table 2. These were 10.5 to 17 tons per acre per year for dry matter, 2,164 to 2,405 pounds per acre for crude protein and 1,110 to 1,638 pounds per acre for digestible crude protein. When the grass was harvested twice per 10 weeks (A & B) instead of once (C) although dry matter yields were lower, yields of crude protein and digestible crude protein were higher.

Table 1. Effect of Crude Protein Content on Apparent Digestibility Percentage

Constituents	Crude Protein Content (%)		
	5-8	8-11	Over 11
Digestibility of:			
Crude Protein	39.0	63.5	70.2
Dry Matter	55.2	60.8	61.7
Crude Fibre	61.9	70.0	71.4
Nitrogen Free Extracts	56.2	58.8	56.4
Total Digestibility Nutrients	51.4	58.1	58.1

Table 2. Harvesting Regime and Yields of Pangola Grass

Yield	A	B	C
Dry Matter (tons/acre)	10.5	11.1	17.1
Crude Protein (lb./acre)	2485	2255	2164
Digestible Crude Protein (lb./acre)	1638	1407	1110
Per cent Digestibility of Crude Protein	66	62	51

Note: Harvesting Intervals:- A and B = twice per 10 weeks
C = once per 10 weeks.

The pattern of dry matter production given in Figure 1 (lower) shows a decline during the winter between November and April. At the same time, the concentration of crude protein (Figures 1 (upper) and 2) moves in an opposite direction. Therefore the highest concentration of crude protein occurs at the period of lowest dry matter production. Figure 3 illustrates the production pattern of crude protein and digestible crude protein throughout the year, with production peaks in autumn and early spring. Thus the time of highest crude protein production does not correspond to the time of highest crude protein mentioned before for multi grass species including a winter grass, and these selections must be able to stand up to the management system that will be imposed on them. It is necessary to have of each specie such knowledge as the growth habit, production potential, nutritive value, water and fertilizer requirements, recovery rates, ability to withstand trampling, need for rest periods etc. It is also essential that the product of this type of research be translated into simple farm practices. At the moment selections from the Oakes Foundation are still in small plots in Jamaica but these must be moved out and systematically evaluated along lines mentioned above.

Foremost among the husbandry practices emanating from research is an increase in fertilizer use at such quantity, type and pattern of application as to dramatically increase the quality and quantity of forage on offer. At present the more progressive farmers use up to 15 cwt. per acre per year compared to a national average of 2.5 to 3 cwt. of fertilizer, and weight gains of more than 1,000 pounds per acre per year from beef cattle have been achieved. Research areas necessitating further work include studies on the water holding capacity of certain soils, soil moisture/fertilizer inter relations, fertilizer frequency and uptake studies, and nutrient availability for different grass species on various soil types.

The need to improve pasture quality by using grass/legume mixtures has been indicated in recent years. Until now not much success has been achieved with grass/legume mixtures in Jamaica. These mixtures appear difficult to manage and maintain perhaps because of their differential recovery rates. It appears, however, that grass quality can be improved by planting pure stands of grass and legumes in such ratio as three parts of grass to one of legume, so that by cutting them separately and mixing them together, good quality forage can be secured. It is perhaps necessary to isolate those areas suited for growing such legumes as Alfalfa. Specialist activities should be concentrated in such areas.

More recently some research relating to the nutritive value of grass has been undertaken in order to formulate and modify grass management systems for greater efficiency. It is felt that in order to reduce feed cost, grass utilization must be maximised before concentrate supplementation is considered, and that concentrate should be fed only in relation to what is possible from grass. Some research data from pangola grass is utilized in this paper to illustrate this approach.

Some early work on the digestibility of pangola grass in Jamaica (Thomas & McLaren, 1971) concluded that the crude protein fraction of the grass was the most variable feature, both in content and digestibility and appeared to offer the most important index for assessing the nutritive value of the grass. The data in Table 1 indicate that the crude protein content should not be less than 8 per cent of the dry matter to meet the maintenance and growth requirements of ruminant animals.

More recently studies of a longer nature on the production, proximate analyses and digestibility characteristics of pangola grass concentration - the latter during the winter months, but occurs at those periods when dry matter production is rising and crude protein content falling and vice versa.

Other features worthy of note are that the content of soluble sugar increased with age of grass, and there was an inverse relationship between crude protein and soluble sugars. The effect of rainfall was significant in that an increase not only significantly increased dry matter production but increased the percentage of crude fibre and decreased that of crude protein in dry matter. This has important consequences on milk production during the wet season, when dry matter intake should be increased by stall feeding of materials such as hay or silage. Mean dry matter digestibility varied between 62 and 69 per cent and that of crude protein between 53 and 72 per cent. Crude protein digestibility was significantly related to the crude protein content of the grass.

In the face of such changes and fluctuations in nutritive value over the year arises the problem of grass management such as for example, how to optimise returns of energy and protein from pastures and fit these nutrients to meet animal demand. As far as pangola grass is concerned the studies referred to suggest a qualitative and quantitative limitation of the grass operating at two different times of the year. There must therefore be management to maintain quality over the spring and summer months when grass is abundant, and management for quantity during the winter season when grass is scarce but of good quality. The findings from the research cited has been translated into a feeding guide.

Agency Policies

The policies referred to are essentially those of Government and would relate to such decisions as will affect land tenure and patterns of ownership. These policies will also include incentive programmes and subsidies such as will accelerate an increase in animal population and stimulate pasture development. Any change in the pattern of land ownership from one type of farmer to the other, especially in the beef industry, is likely, outside of public ownership, to have the effect of reducing the size of the operation. Therefore it may become necessary to specify in each locality the scale of operation and farm size needed for a profitable beef cattle enterprise. Failing that, some alternative type of meat producers, e.g. sheep and goats might have to be located in these areas, or some intensive research undertaken on how to carry beef on restricted acreages. In addition it would appear necessary to incorporate in such a policy some type of incentive programmes, e.g. Government subsidies for fertilizer and pasture renovation, and Government's involvement in small hill farmer calf rearing programmes. Such a programme will mean that all calves will be reared outside the dairy complex. Such a programme will benefit all the farmers concerned and the nation as a whole.

Summary

The problems of pasture management in the development of the livestock industry in Jamaica have been discussed against the back-

ground of land allocation estimated at half a million acres; about half of which is in improved pastures, one-third in unimproved pastures and the remainder in ruinate. The present cattle population is estimated at 192,000 animal units of beef and dairy (beef 146,000, dairy 46,000) and the projected cattle population for national self sufficiency of milk and beef in 1980-81 is estimated at 316,000 animal units (beef 190,000, milk 126,000) on 450,000 acres. The remaining 50,000 acres chiefly marginal and sub-marginal land will be devoted to sheep and goats.

The problems are basically those related to an intensification of the carrying capacity of pastures, and an increase in the efficiency of fodder utilization. The strategy for solving these problems resolves around centralization, specialization and intensification within the livestock industry and discussion is centered around topics such as the present and future locations of the industry, ecology, forage conservation, farmer efficiency, management, financial and research inputs, and agency policies.

As far as dairying is concerned this industry must be sited in suitable locations (some areas already identified) such that three types of specialization can be developed and utilized. Within the dairy complex or in close proximity to it exists the need for the specialist forage farmer preferably on the best lands and ecological situations. The dairy operator must be located or relocated in areas specifically selected because of certain infrastructural facilities and suitability for dairy farming and should be devoted exclusively to milking at full capacity. Calf and heifer rearing programme should be developed especially by the small farmer in areas outside of the dairy complex. Major effort should be directed to this aspect of development. This specialised approach to dairying should be integrated under some type of central programming such that each area of speciality does not develop in isolation, but concurrently with each other such that national targets can be achieved.

In the beef enterprise the improvement of pasture management practices on lands currently in beef is calculated to supply fodder for an estimated population increase of about 30 per cent. The need exists for specialised forage production and to establish farm practices aimed at eliminating weeds, improving ground cover, maintaining good stands of grass and increasing fodder output.

The need to increase farmer efficiency in attitudes and techniques appears as a cardinal one for development; as are others outside of farmer control. Some of these are associated with major programmes and policy decisions; and include adequate financing, research, irrigation and drainage facilities. Other recommendations have been given in the type of inputs considered necessary in the move towards national self-sufficiency. These include the need to establish multigrass species with selections for winter growth, and to intensify research in areas including management studies, the use of comfith for dairying, the nutritive value of grass, soil-moisture-fertilizer inter-relationships for various grasses and implements technology.

Table 1. Feeding Guide for Pangola Grass; Division of Livesotck Research, Bodles, 1969-1971.

Guide to Feeding	January - April	May - June	July - September	October - December
1	Crude protein high in grass.	Crude protein falling.	Crude protein low.	Crude protein increasing to high.
2	Grass quantity low.	Grass quantity high.	Grass quantity falling.	Grass quantity medium.
3	Feed at longer intervals (5-7 wks.).	Feed at shorter intervals (3-4 wks.).	Feed at 4-5 wk. intervals.	Feed at 4 wk. intervals.
4	Feed hay, silage, molasses, citrus pulp, cane tops etc.	-	Feed hay, silage etc. if necessary.	-
5	Feed high energy concentrate for milk production.	Feed concentrate to get adequate dry matter intake for milk production.	Feed high protein and high energy concentrate for milk production.	Feed high energy concentrate for milk production.
6	-	Make silage, hay depending on weather.	-	If grass abundant make hay, silage.
7	Provide adequate supply of water, minerals etc.	Provide adequate water, minerals etc.	Provide adequate water, minerals etc.	Provide adequate water, minerals etc.

Crude Protein (%)	Regrowth Interval	Mean	Range	Mean	Range	Mean	Range	Mean	Range
	4 wks.	12.0	(8.5-16.5)	11.5	(8.5-13.5)	10.0	(10.0-14.0)	13.0	(10.0-17.0)
	6 wks.	11.5	(8.0-16.0)	8.0	(7.5-9.5)	7.5	(7.0-8.0)	9.5	(8.5-11.0)
	10 wks.	8.5	(8.0-8.7)	6.0	(5.0-6.0)	5.0	(4.5-6.0)	8.0	(7.5-8.5)

	January - April	May - June	July - September	October - December
Rainfall	Low. Av. total 20 wks. = 4.5 in.	Higher. Av. Total for 10 wks. = 8.4 in.	High. Av. total 10 wks. = 15.0 in. Distribution variable	Av. total 10 wks.=9.4 in. More in 1st part of per period.
Characteristics of dry matter production	Six wks. regrowth 1.5-2.0 times greater than 4 wks. Both of high quality.	Spring flush. High yields at 4 or 6 wks. Four wk. regrowth better quality.	Six wks. yields at times 2.5 times greater than 4 wks. Grass matures and high seeding.	Six wks. regrowth yields 1.5-2.0 times greater than 4 wks. Good yields first part of period.

Remarks: Input of fertilizer to achieve Crude Protein values given were 15 cwt. sulphate of ammonia/ac/yr. (3 cwt./ac/10 wk.) and one cwt. each of Muriate of Potash and triple Superphosphate applied in two equal proportions in spring and autumn. Irrigation water was applied at rate of 2 in/fortnight. Dry matter yields varied for 10.5 to 17 tons from these trials.

Figure 1. Crude Protein Percentage (Upper) and Dry Matter Production (Lower) for Cutting Regimes A(4A + 6B), B(6A + 4B) and C(10 Wks.)

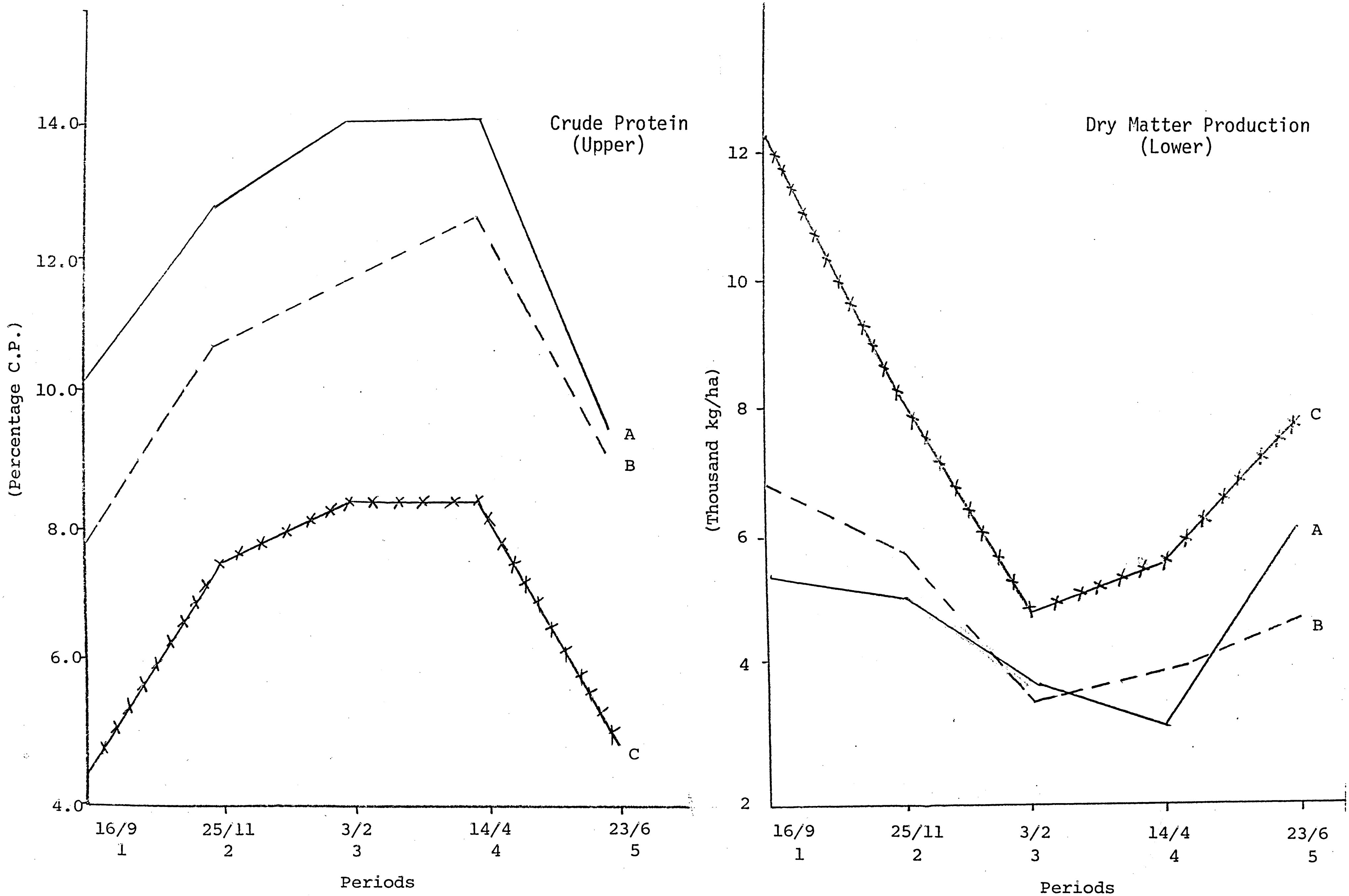

Figure 2. Crude Protein Percentage According to Regrowth Intervals of 4, 6 (precuts) and 10 weeks.

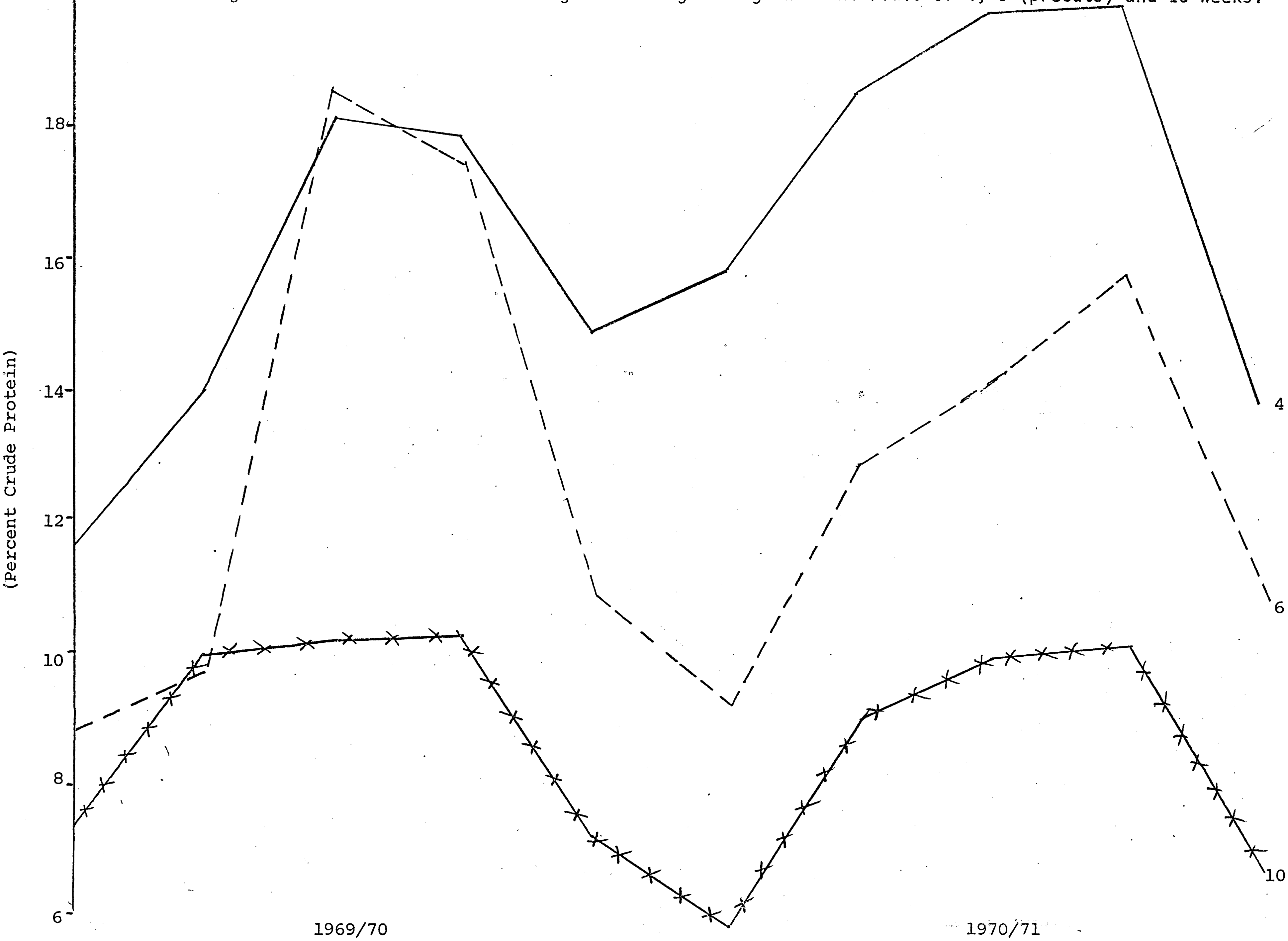

Figure 3. Distribution of Total Crude Protein (upper) and Digestible Crude Protein (lower) for Grasses of Culling Regimes A,B & C, respectively.