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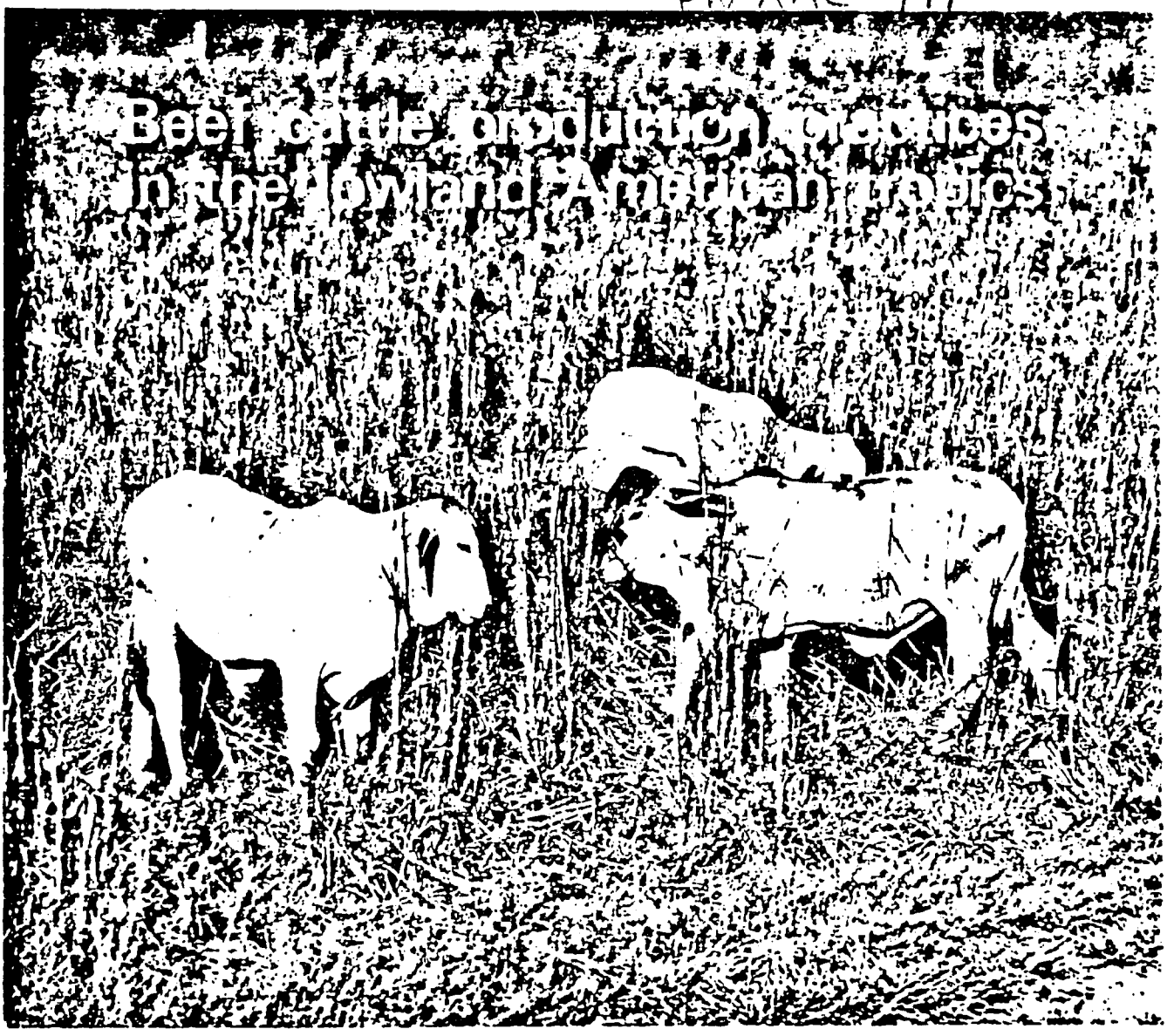

by N.S. Raun

The ecosystems and socio-economic environments in the tropical lowland regions of Latin America vary greatly. Ecosystems may include new fertile soils and old infertile ones, desert regions and areas with an average annual rainfall as high as 10 000 mm, open savannas and dense rain forests, and level as well as hilly topography. Socio-economic environments are influenced by the unique cultural and economic characteristics of a given area, and by the ecosystem.

This article is concerned with basic production practices that should be considered in the development of beef cattle production systems for savanna regions in the lowland tropics of Latin America. Usage and adaptation of individual and combined inputs should be determined by the particular conditions of a given production situation. Consideration is given to technical inputs for production systems using grasslands in areas that are not suitable for crop production, and to the immediate utilization of potentially arable lands for grazing until the necessary infrastructure for crop farming can be developed.

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Land use

In 1972 beef cattle in Latin America and the Caribbean were estimated to number 247 million (FAO, 1973), 150

(Left) Early weaning can often improve rebreeding of cows that are on a low plane of nutrition

million of which were in tropical lowland regions, half being in the infertile savanna areas and the other half in the more fertile soil areas.

Allic soils predominate in the infertile savanna areas. These soils are mainly the red-yellow latosols, or oxisols and utisols. They are highly weathered, quite acid (pH 4.5-5.0), highly aluminium saturated, and very low in bases (Ca, Mg, K) and phosphorus. The allic soil savanna lands comprise a land area of 300 million hectares and have potential for increased productivity. Since most of these lands cannot support sustained crop production without sizable fertilizer inputs, grazing by ruminants appears to be the only feasible method of utilization in the foreseeable future.

The fertile soil grassland regions include approximately 370 million ha, of which part is now grassland and part is forested land that could be cleared and developed as grassland.

Animal productivity

Animal productivity is low in the lowland tropics of the Americas. Most cows calve once every two years, giving a calving rate of approximately 40 to 50 percent. Slaughter animals are marketed at 3 to 5 years of age, when they weigh 350 to 450 kg. This results in extraction rates of approximately 13 percent, with an annual production of carcass beef from the total beef herd of only 25 kg per head (FAO, 1973). This compares with 36 kg in Argentina and 49 kg in Australia, where only pasture-based production systems are used. In the United States, however, where forages provide approximately 73 percent of the total feed units and 23 percent is derived from grain, the production of carcass beef per animal is 80 kg (Feedstuffs, 1975).

Productivity per hectare is also low. Combining all types of land used for grazing (approximately 670 million ha), the stocking rate averages 4.5 ha per animal, and carcass beef production is only 5.1 per ha per year.

The International Centre of Tropical Agriculture (CIAT) recently conducted two surveys in the Colombian llanos, a region comprising open savannas with infertile allic soils, to determine production levels and identify restraints. In the first survey on 40 small- to medium-sized farms that had received breeding females on contract, calving rates ranged from 15 to 81 percent, with 30 percent of the farms having rates above 60 percent (Stonaker *et al.*, 1975b). In the second survey conducted on larger farms, calving rates varied from 29 to 76 percent, calf mortality from 0 to 60 percent and adult mortality from 0 to 6 percent (Centro Internacional de Agricultura Tropical, 1975).

In a survey conducted on the north coast of Colombia, a generally fertile soil area, mean production levels were higher than in the llanos. This reflects a higher plane of nutrition attained as a consequence of a higher soil fertility supporting growth of more nutritious pasture forage. Preliminary information from another survey now in progress on the north coast substantiates these observations (R. Schellenberg, personal communication).

Productivity can be markedly increased through the adaptation and application of known technology. In the Colombian Agricultural Institute (ICA)/CIAT collaborative herd systems experiment in the llanos, acceptable production levels are being obtained from grade zebu cattle that graze native grass pastures and receive mineral supplementation under improved herd management practices (Centro Internacional de Agricultura Tropical, 1975). Calving rates have increased from 49 to 71 percent, and where molasses grass (*Melinis minutiflora*) pastures are used in the rainy season, somewhat higher calving rates (78 percent) have been obtained. Another innovation, early weaning, has increased calving rates to as high as 90 percent.

At the ICA Turipana station in the fertile Sinu river valley on the north coast of Colombia, calving rates of 86 percent have been achieved (Instituto Colombiano Agropecuario, 1972). Even higher production levels (with calving rates as high as 91 percent) have been obtained at the Pichilingue station of the National Agricultural and Livestock Research Institute (Instituto Nacional de Investigaciones Agropecuarias, 1974).

Production constraints

Although acceptable levels of productivity can often be achieved through the application and adaptation of available technology, there are nutritional, disease and germ plasm constraints on achieving the production potential of the feed-animal continuum.

Inadequate nutrient intake from grazed forages, particularly during the dry season, is a principal constraint on the general attainment of high levels of productivity. The severity of this constraint varies with the distribution and amount of rainfall and tends to be accentuated in the low fertility areas.

Disease and parasitism also limit productivity. Most disease agents have been identified, and available basic technology makes it possible to develop and implement effective, economic disease control programmes. However, there are some major technological gaps. The currently used foot-and-mouth disease vaccine confers immunity for only four to five months; it is in fact a deterrent to effective control and is costly to the producer. Tick control methods are inefficient and costly.

Genetic potential places an ultimate limit on productivity. In many instances animals are not producing up to the potential of the current feed-management continuum. Genetic potential will become increasingly limiting as other constraints are removed and as higher production levels are sought.

Production practices for the lowland tropics

On the basis of past experience, the following practices may be recommended as being generally suitable for application throughout the lowland tropics. These include herd and pasture management practices, establishment of improved pastures, mineral and protein supplementation and beef/milk production. Specific recommendations relating to infertile and fertile soil areas will be considered later. Herd health is not considered, as ample information is available elsewhere.

Herd management practices. Only bulls that have shown good growth and fertility should be used for breeding. One bull will be required for every 20 to 30 cows. The bulls should be used alternately and rested for periods of two to four weeks. A high plane of nutrition on pasture is essential to maintain the bulls in good breeding condition.

Non-breeders and old cows should be rigorously culled because the direct costs involved in maintaining them will generally exceed the value of the limited number of calves produced.

Seasonal breeding facilitates the programming of breeding and calving at the most propitious times of the year, simplifies management and reduces labour costs. However, continuous breeding should be used where management skills and information are insufficient. It is also advantageous in dual-purpose herds where cows with nursing calves are milked throughout the year.

Significant improvements in productivity of *Bos indicus* and *Bos taurus* cattle can be achieved through selection (Plasse, 1975). Crossbreeding should be considered where the management system is sufficiently advanced to allow implementation of such a programme; heterosis levels may be expected to be higher than those reported in temperate climates (Stonaker, 1975; Plasse *et al.*, 1974).

Although calves are generally weaned at about 9 months of age, there is considerable evidence that they can be weaned at 6 to 7 months without serious impairment of growth. Also, this will often result in a marked improvement in rebreeding of the cow, as it will stop the nutrient drain for lactation, particularly for cows that are on a deficient plane of nutrition. However, the nutrition of the calf becomes more critical if weaning age is further decreased. As far as possible, high quality pastures/forages should be provided to meet nutrient requirements, thus minimizing or eliminating the need to provide concentrates (Centro Internacional de Agricultura Tropical, 1975; Gomez *et al.*, 1975).

Pasture management. Pastures should be seasonally grazed in order to take advantage of their maximum production potential. High-lying well-drained areas should be preferentially grazed in the rainy season when soil moisture is adequate to support plant growth, and the low-lying high water table areas should be grazed in the dry season.

Invasion of weeds is generally a consequence of incorrect range management or unsuitable pasture species, and should be treated accordingly. Routine use of chemicals should generally be limited to troublesome weeds that are difficult to control and/or eradicate through management and cultural practices (Doll, 1975).

A relationship between stocking rate and efficient utilization of forage that does not result in deterioration of the pasture is often delicate and highly location-specific. Perhaps an extreme example is the replacement of a less desirable species (*Trachypogon vestitus*) by a more desirable species (*Axonopus compressus*) as stocking rate increases (Paladines, 1974).

Under extensive management conditions where pasture forage production exceeds consumption, periodic burning can be an important management tool (Paladines, 1974). Burning toward the end of the rainy season helps to provide higher quality pasture going into the dry season. However, burning should not be used under conditions where pasture forage is limiting, nor should it be used in improved pastures, particularly legume-grass associations.

Improved pastures. Practically every beef cattle enterprise — whether small or large, intensive or extensive, in fertile or infertile soil areas — should have a programme for the establishment of improved pastures. The extent of improved pasture will generally be determined by the nutrient requirements for the critical phases of the production cycle, i.e. breeding, weaning and fattening. Improved pastures will assume greater importance as grazing land becomes limiting, as higher production levels are sought, and as land use becomes intensive.

Many adapted grass species that will withstand grazing can be used over a wide range of situations for the establishment of improved pastures. Some, like pangola (*Digitaria decumbens*), para (*Brachiaria mutica*), star grass (*Cynodon nlemfuensis*) and guinea grass (*Panicum maximum*), are suitable for the more fertile areas. Others, like molasses grass (*Melinis minutiflora*), *Brachiaria decumbens*, *Hyparrhenia rufa*, *Paspalum plicatulum* and tanner grass (*Brachiaria rugulosa*), are suited to infertile soil areas where there is little or no application of fertilizer.

Forage legumes included in grass swards offer the possibility of increasing productivity, particularly in the dry season, because of their high protein content, drought resistance and capacity to fix nitrogen in the soil in association with soil rhizobia. In some areas native legumes abound in association with grasses. But very few tropical forage legume varieties are available for commercial use. However, experimental evidence from the ICA/CIAT experiments indicates that liveweight gains of growing-fattening cattle on *Stylosanthes guyanensis*-grass associations in the llanos can be as high as 150 to 250 kg per ha per year as compared with 60 to 100 kg on improved grass pastures and 10 to 20 kg on native grass pastures (Centro Internacional de Agricultura Tro-

Growth rate can be markedly increased by crossing the adapted Bos taurus San Martinero breed with the zebu

pical, 1974). More important still, cattle grazing stylograss pastures during the dry season registered weight gains of as high as 40 kg, whereas cattle on improved and native grass pastures suffered weight losses of up to 50 kg. Exploitation of potential depends on identifying species and varieties that are superior to native grasses and will withstand grazing (Raun, 1975).

Mineral supplementation. While the formulation of optimized mineral supplements will be area-specific, it is possible to make general recommendations which could be adapted to local situations. A mineral supplement based on a good phosphorus source, fortified with the trace minerals that are deficient in pasture forage and including only enough salt to ensure palatability, should generally be routinely provided on an *ad libitum* basis, particularly in infertile soil areas. Many pasture species are deficient in phosphorus, especially those grown on low-fertility soils. Although information on trace mineral content of pasture forages is limited, it is generally advisable to fortify the mineral supplement with cobalt, iodine, and copper (Fick *et al.*, 1976). The amounts required are small and cost little. Other trace minerals, i.e. zinc, iron and manganese, will generally not be required.

Protein supplementation. In situations where the dry season is severe and long, it may be advisable to provide a protein supplement to prevent undue weight losses, long calving intervals and delayed marketing of feeder cattle. However, compensatory gain in the rainy season must be considered in evaluating the economics of supplementation.

But where the dry season is less severe and of shorter duration, protein supplementation will often not be economic. In the ICA/CIAT herd systems experiment in the Colombian llanos, supplementation of cows with 80 g urea, 500 g molasses and 4 g sulphur per head per day during the last three months of a four-month dry season reduced weight losses but did not improve calving rate during the first two years of experimentation (Centro Internacional de Agricultura Tropical, 1975). However, possible residual effects in the longer term are as yet undetermined. Dry season supplementation of zebu steers likewise had a limited effect on annual weight gains; although supplemented animals weighed more than non-supplemented animals at the end of the dry season, the latter recovered 50 to 71 percent of this weight difference owing to higher weight gains during the subsequent rainy season (Centro Internacional de Agricultura Tropical, 1974, 1975).

Beef/milk production. Many so-called beef cattle herds are used for both beef and milk production. A recent evaluation of the Colombian livestock industry indicates that 46 percent of the milk that enters commercial channels comes from beef cattle herds, most of which are located in tropical climates (Ministerio de Agricultura, 1974). The milk produced represents a principal source of income, particularly where the livestock industry is more developed and where there is a demand for milk in the urban centres. An example is the north coast of Colombia, where Rivas (1974) found that on farms of up to 200 ha, sales of milk accounted for 33 percent of total income. The corresponding figures for farms of 200 to 500 ha and over 500 ha were 30 percent and 13 percent respectively. This is especially significant when one considers that milk production averaged only 2.5 litres per cow per day in the dry season and 3.1 litres in the rainy season.

The usual practice in beef/milk herds is to separate the calves from the cows in the evening, milk the cows in the morning, leave some milk for the calf, and allow the calf to be with the cow during the day. Continuous rather than seasonal breeding is generally used in these beef/milk systems.

Particular attention should be given to the dry season feeding of the cow and to the nutrition of the calf. Provision for nutritious dry season pastures is crucial, e.g. grass-legume associations. Browse legumes such as *Leucaena leucocephala* might be considered (Hutton, 1974). Fresh chopped sugarcane might serve as an effective energy supplement (Preston, 1974). Conservation of forage produced during the rainy season as hay or silage and other methods of supplementation might also be possible approaches to resolving dry season nutrient deficiencies.

Once a day milking of beef cows is a common practice in the lowland American tropics

Infertile soil areas

The unique problems of beef cattle production in infertile soil areas arise from the low nutritive value of grazed forages, which is principally a consequence of low soil fertility. These problems are accentuated in the dry season. The most serious consequences are an increase in calving intervals and an increase in market age of the animals. In the short term, the remedy lies in improved herd and pasture management practices combined with mineral supplementation, and in the establishment of improved pastures needed to offset inadequacies in nutrient intake during critical phases of the production cycle (Stonaker *et al.*, 1975a).

Mineral supplementation is especially critical in the low-fertility allic soil regions. The phosphorus content of grass species in the llanos, for instance, ranges from 0.07 to 0.09 percent (Centro Internacional de Agricultura Tropical, 1973). Even the tropical legumes that are adapted to these allic soils are often deficient in phosphorus; the phosphorus content of *Stylosanthes guyanensis* is approximately 0.13 percent, which is marginal or below that required for satisfactory growth and reproduction (Centro Internacional de Agricultura Tropical, 1973). In the ICA/CIAT herd systems experiment in the Colombian llanos, mineral supplementation of grade zebu cattle grazing native pastures has increased the annual calving rate from 49 to 71 percent during the initial two-year period (Centro Internacional de Agricultura Tropical, 1975). In addition, mineral supplementation has increased growth rate and significantly reduced abortions, bone fractures, age at first calving and the period to slaughter.

In the long term, with more intensive land use increased attention must be given to the expanded establishment of improved pastures with higher carrying capacities and higher nutritive value.

Fertile soil areas

The greater agricultural development, increased competition for land use, expanded market possibilities and greater production potential of the fertile soil areas call for more intensive production systems and practices. Particular attention should be given to the selection of pasture species that are not only nutritious and high-yielding, but can also withstand grazing on a continuing basis and be competitive with weeds. The greater frequency of milking cows in beef cattle herds in the fertile soil areas and the higher incidence of disease and parasitism associated with increased concentrations of cattle also require improved managerial and preventive medicine programmes.

Summary

There are about 250 million head of beef cattle in Latin America and the Caribbean, of which approximately 150 million are estimated to be located in the lowland tropical areas and are equally divided between the infertile savanna areas and the more fertile soil areas.

Productivity per animal and per hectare is low in the tropical regions of Latin America. The annual production of carcass beef is only 25 kg per head. It is estimated that calving rates are 40 to 50 percent, marketing age 3 to 5 years, and over-all stocking rate 4 to 5 ha per animal, resulting in a carcass beef production of only 5.1 kg per hectare per year.

The primary cause of low productivity is inadequate nutrient intake from grazed forages, particularly during the dry season. The effects of disease, parasitism and genetic potential are generally secondary to inadequate nutrition.

Despite these constraints, the application of available technology can result in significant improvements in productivity and can support the development of economically viable beef cattle-based farming units. This would involve the application of improved herd and pasture management practices. Herd management practices include selection, husbandry and health programmes. Pasture management includes seasonal use of pastures and the establishment of improved pastures when necessary to provide an adequate nutrient intake during the critical phases of the production cycle which cannot be provided by existing pastures. The critical production phases include breeding season, weaning of calves and fattening of animals to be slaughtered.

Particular attention should be given to the management and nutrition required for the dual production of beef and milk in traditional beef cattle herds. A significant proportion of the milk that enters commercial channels is produced by these herds.

The unique problems of beef cattle production in infertile soil areas arise from the low nutritive value of grazed forages. In addition to improvements that can be obtained through better herd and pasture management practices, attention should be given to the establishment of improved pastures in order to provide an adequate nutrient intake during the critical phases of the production cycle.

More intensive beef cattle production systems prevail in areas where soils are more fertile, and this pattern will become more accentuated as agricultural development proceeds, competition for land use increases, and demand for animal products becomes greater.

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