# FATTENING STEERS UNDER GRAZING CONDITIONS

By

Manuel L. Ruiz, Ph.D.

Head, Department of Animal Production

Tropical Agricultural Research and Training Center (CATIE)

Turrialba, Costa Rica 7170

While in the developed countries beef production systems usually include the feeding of high-energy rations to young animals, most of the beef produced in the developing countries still comes from extensive systems of production. These systems take two general forms: In the case of small farmers, most practice the so-called dual purpose cattle enterprises which include the once-a-day milking of Zebu type cows and where beef production is represented by the sale of weaned calves and culled cows; in the case of ranchers, extensive grazing of beef-breed herds is practiced whether the operation is cow-calf or growing-finishing of purchased steers. In any of these three situations, beef output may be as low as 7 kg/ha/year on a carcass basis, and acceptable carcass weights (equal to or above 150 kg) can only be achieved when steers are 4 to 5 years or older (1, 8).

## THE SEASONALITY OF PASTURE AND ANIMAL PRODUCTION

The long time required to produce marketable steers is primarily the result of climate-dependent curves of pasture and animal growth consisting of periods of good animal weight gain followed by periods where this gain is partly lost due to feed scarcity. This situation has also been described for the Australian tropical region (6) and represented in Figure 1.



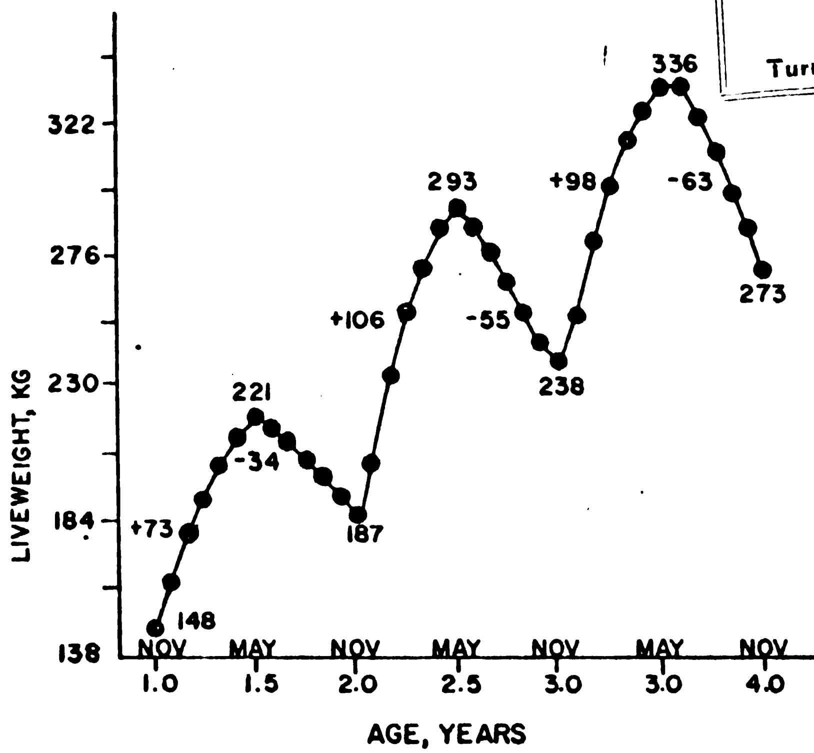


FIG. 1. SEASONAL WEIGHT CHANGES OF CATTLE FROM 1 TO 4 YEARS OF AGE GRAZING NATIVE GRASSES IN THE AUSTRALIAN TROPICS (6).

Variations in the availability of pastures occur in both the dry/humid tropics and the humid areas, the two principal ecosystems in Latin America, as illustrated in Figure 2.

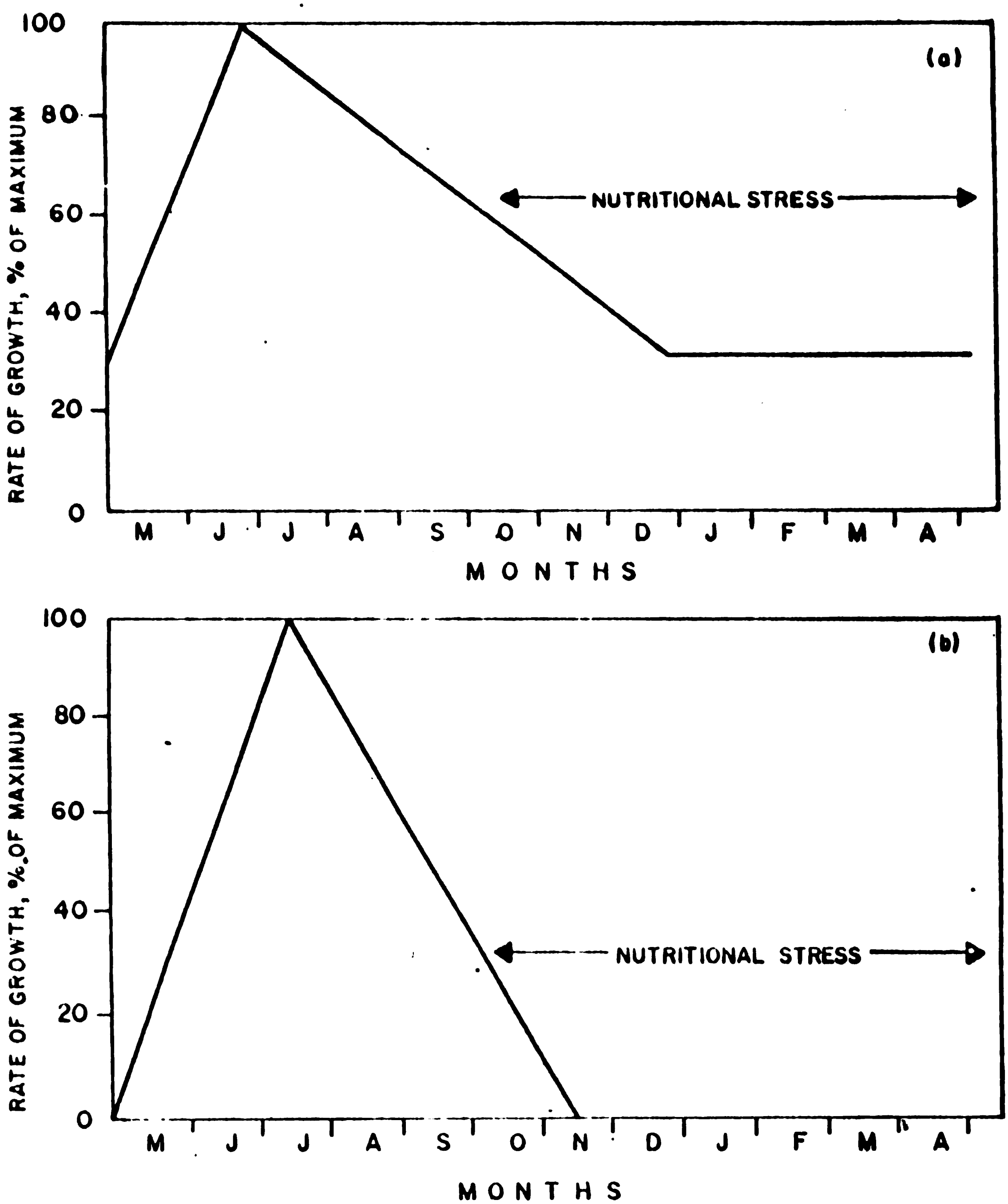


FIG. 2. SEASONAL RATE OF GROWTH OF GRASSES IN (a) THE HUMID TROPICS AND (b) THE DRY/HUMID TROPICS OF CENTRAL AMERICA (4)

Thus beef production in the dry/humid tropics is confronted with a serious seasonal lack of pastures which causes substantial losses in animal product output, including losses by death. During this time, farmers sell cattle in an attempt to reduce stocking rates but with a loss in profits due to market flooding. Obviously, any research and development program designed to improve the nutritional well-being of the herds during the critical dry period is of utmost importance although nutrition is just one component of a complex production system which includes not only biological factors but physical, social and economic factors as well.

In the humid tropics, in spite of the nearly ever-present rainfall, there exist fluctuations in both quantity and quality of grasses. For example, in the Atlantic Slope of Costa Rica, total pasture production may fluctuate from 100% (maximum relative biomass during the most productive months) to only 20%, this being caused by diminished rainfall, lower temperatures, and reduced daylight (4). These variations in forage availability provoke fluctuations in animal productivity which, consequently, is of low efficiency in the tropics as compared to countries with sophisticated technology.

## PROTEIN AND ENERGY LIMITATIONS OF TROPICAL PASTURES

In addition to the fluctuation in pasture productivity, two other constraints to grazing systems must be recognized. One is the seasonal impoverishment of the protein content in grasses, such as Jaragua grass (*Hyparrhenia rufa*), as the dry season settles in, reaching levels as low as 2% CP (13). This, obviously, will restrict feed intake and animal productivity. The other additional constraint is the generally low or modest level of digestibility which partially explains the lower weight gains found in cattle grazing tropical grasses (Table 1).

**Table 1. Comparative weight gain of cattle grazing tropical or temperate grasses or concentrates (3, 9, 12)**

| DIET | DM DIGESTIBILITY % | WEIGHT GAIN KG/HEAD/DAY |
|---|---|---|
| Tropical pasture | | |
| 1. Immature | 60 - 65 | 0.7 - 0.9 |
| 2. Semimature | 50 - 55 | 0.4 - 0.5 |
| 3. Mature (dry season) | 33.5 | -0.225 |
| Temperate pasture | 70 - 80 | 0.9 - 1.2 |
| Concentrate rations | 80 - 85 | 1.2 - 1.4 |

## BASIC STRATEGY FOR INCREASING BEEF PRODUCTION UNDER GRAZING CONDITIONS

On the other hand, tropical grasses grow vigorously and far exceed temperate grasses in total biomass production. Under high humidity and fertilization conditions, tropical grasses produce six times as much material as temperate grasses. As water availability decreases the differences become less evident (Table 2).

Therefore, the primary strategy to increase beef production in tropical areas is to saturate the capacity of the grassland to supply feed for the herd. This capacity depends on the nutritive quality of the forage and the total biomass produced. The nutritive quality will be reflected in the animal's rate of weight gain, while the forage yield will determine the stocking rate, this in terms of animal units/ha or total animal weight/ha. The product of these two factors will be the amount of beef that is produced per hectare. These relationships have been theoretically considered in a well-known model (Figure 3).

Table 2. Estimates of the total annual dry matter production (tons/ha) of grasslands in the main climatic zones of the world (11)

| | WATER SUPPLY | | | |
|---|---|---|---|---|
| TEMPERATURE | WET | HUMID | SEMI-ARID | ARID |
| Sub-artic | 4 | 8 | 9 | - |
| Temperate | 25 | 15 | 10 | 4 |
| Sub-tropical | 120 | 40 | 10 | 4 |
| Tropical | 150 | 70 | 12 | 4 |

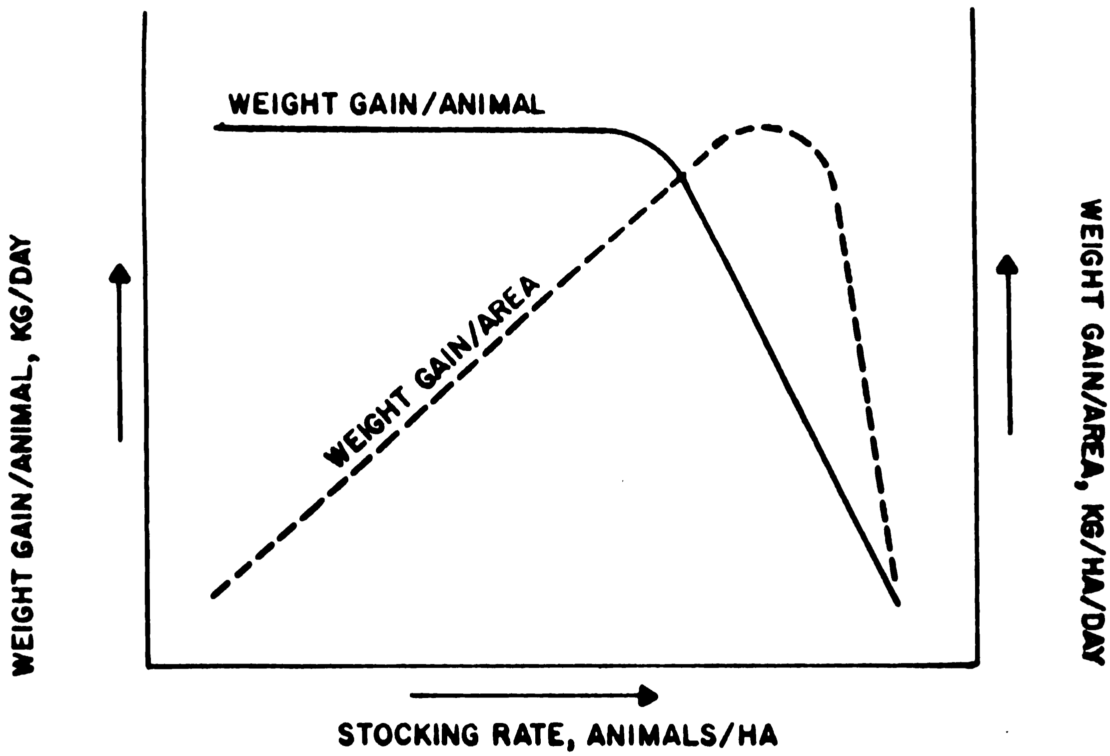


FIG. 3. THE EFFECT OF INCREASING STOCKING RATE UPON PRODUCTIVITY PER ANIMAL AND PER UNIT AREA (7)

In general, Figure 3 indicates that at low stocking rates the maximum individual performance is obtained (the extent of which is dependant upon the forage quality and the animal's genetic ability). As stocking rate increases (i.e. forage availability/animal diminishes) a point will be reached after which the individual performance will decrease. Nevertheless, beef output per hectare will continually increase until a maximum is reached and, at an extreme stocking rate, a rapid fall in animal production per hectare will ensue.

An illustration of the model's operation is given in Table 3.

**Table 3. Productivity of savannah grasses in terms of cattle weight gains per head and per hectare (5)**

| COUNTRY | STOCKING RATES ANIMAL/HA | WEIGHT GAIN IN 203 DAYS | |
|---|---|---|---|
| | | KG/HEAD | KG/HA |
| Nigeria and savannahs | 0.42 | 21 | 9 |
| of Northern Guinea | 0.50 | 26 | 12 |
| | 0.62 | 24 | 16 |
| | 0.83 | 19 | 15 |
| | 1.25 | 1 | 3 |

## REFINEMENTS OF THE BASIC STRATEGY

Now, given a suitable pasture species and knowing the optimum carrying capacity, there are three ways by which beef production can be further increased. These are:

- The use of fertilizer
- The use of associated legumes
- The use of supplements

Briefly, each of these methods will be illustrated.

**FERTILIZATION:** Normally, N is the limiting growth factor of tropical grasses even when the humidity and temperature are adequate. The extent of the response to N applications will depend chiefly on the specific pasture. Thus, Elephant grass (*Pennisetum purpureum*) will show extraordinary responses to N up to 800 kg N/ha/year, while grasses like Molasses grass (*Melinis minutiflora*) will hardly respond to fertilization.

Fertilization with N will modify, in most species, the growth pattern so that the growing period is extended well into the dry season when N is applied towards the end of the rainy season. However, this will not prevent the normal loss of the nutritive value due to the dry season (13).

Moreover, contrary to common beliefs, fertilization with N will not cause obvious increases in the crude protein values. Rather, the main effect is a significant increase in total biomass production and, therefore, an increase in the pasture's carrying capacity. Table 4 shows a sample of results directly related to the above concepts.

**Table 4. Beef production on fertilized Pangola grass (Digitaria decumbens) in Puerto Rico (14)**

| FERTILIZER LEVEL KG N/HA/YEAR | STOCKING RATE ANIMALS[a]/HA | WEIGHT GAIN | |
|---|---|---|---|
| | | KG/HEAD/DAY | KG/HA/YEAR |
| 64 | 2.0 | 0.56 | 404 |
| 168 | 3.2 | 0.55 | 642 |
| 382 | 4.9 | 0.55 | 990 |
| 535 | 5.9 | 0.49 | 1070 |

[a] 300-kg steers

**GRASS/LEGUME ASSOCIATIONS:** The rising cost of fertilizers has forced researchers to re-address the search for suitable, highly productive and persistent legumes in association with grasses. Recently, this search has included the evaluation of legume trees and shrubs. In those cases where legumes have been successfully introduced, dramatic increases in beef production have been obtained. One important feature of legumes is their most significant contribution to the alleviation of the nutritional stress during the dry seasons; in fact, they can support weight gains throughout this critical period as may be seen in Table 5.

As a partial summary, Table 6 compares the production potential of various types of pastures both in temperate and tropical climates. It is clear that native tropical grasses have serious limitations for

**Table 5. Beef production based on grasses or grass/legume associations in areas with more than 1500 mm rainfall (15)**

| COUNTRY | PASTURE | STOCKING RATE ANIM/HA | WEIGHT GAIN KG/HEAD/DAY | KG/HA/YEAR |
|---|---|---|---|---|
| Australia | Panicum maximum | 4.2 | 0.22 | 337 |
| | P. maximum + C. pubescens | 4.2 | 0.30 | 460 |
| Fiji Islands | Dicanthium cari-cosum | 1.5 | 0.22 | 110 |
| | D. caricosum + 10% area with Leucaena leucocephala | 1.5 | 0.30 | 170 |
| | D. caricosum + 20% area with Leucaena leucocephala | 1.5 | 0.50 | 270 |
| Peru | Hyparrhenia rufa | 1.2 | 0.16 | 70 |
| | | 1.8 | 0.23 | 149 |
| | | 2.1 | 0.17 | 130 |
| | Hyparrhenia rufa + Stylosanthes guya-nensis | 2.1 | 0.40 | 309 |
| | | 2.4 | 0.40 | 351 |
| | | 2.7 | 0.34 | 335 |
| | | 3.0 | 0.34 | 378 |

production although this situation can be vastly improved through the introduction of legumes and the application of phosphorus. It is also evident that temperate grass/legume associations are more productive than tropical associations and, finally, that N-fertilized tropical grasses are superior to N-fertilized grasses in temperate climates.

**SUPPLEMENTATION:** Supplementary feeding is justified by the seasonal variations in both pasture and animal production (see Figures 1 and 2).

**Table 6. Beef production potential of native and improved grasses with or without legumes or fertilization (10)**

| PASTURE | TEMPERATE CLIMATE | TROPICAL CLIMATE MONSOON (5-6 DRY MONTHS) | TROPICAL CLIMATE HUMID |
|---|---|---|---|
| Native grass | | | |
| - Unimproved | 100-400[a] | 10-80 | 60-100 |
| - Associated with Legumes plus P. fert. | 200-500 | 120-170 | 250-450 |
| Improved grass | | | |
| - Associated with legumes plus P-fert. | 400-1200 | 200-300 | 300-800 |
| - Fertilized with N | 700-1400 | 300-500 | 400-1800 |

[a] Weight gain in kg/ha/year

Also, at times, a farmer may find himself with too many animals and a rapidly decreasing productivity per animal and per hectare (see Fig. 3), and he may be forced to look for additional feed resources.

Supplementation is undoubtedly beneficial if a premium price is paid for high quality beef which can only be obtained through sustained weight gains and proper nutrition. Finally, the practice of supplementation allows the farmer to program the sale of fattened steers at times when prices are most favorable.

The success of supplementation, other than economic considerations, will depend on the following factors (2):

- If pasture availability is not limiting, animal performance will be determined by the voluntary intake of energy and protein which in turn depends on the digestibility and protein content of the pasture.
- If pasture quality is low, energy and/or protein supplements will

increase total intake and may even increase the consumption of pasture.

- When pasture quality is high, grazing animals will respond to supplements only if pasture availability is low, thus limiting the amount of pasture that the animal can harvest. Little response will be obtained at low stocking rates.
- At high stocking rates, not only is the available pasture reduced but also the opportunity for selection by the animal is reduced. In this situation, supplementation allows for a more efficient use of the available pasture.

Work at CATIE has led to a model illustrating expected behavior of young bulls grazing Guinea grass (Panicum maximum) and supplemented with molasses/cottonseed meal (Figure 4). Figure 4 illustrates some of the principles stated above and, in addition, presents two other features of supplementation effects. One is what may be called an "additive effect" which simply means that the consumption of small amounts of a supplement does not interfere with the normal consumption of the forage. This, of course, would translate into higher animal productivity. In Figure 4, this would be represented by a 33% increase in rate of gain.

A "substitution effect" of the supplement signifies a competition between the intake of the supplement and the intake of the forage. When this occurs the individual performance may not be affected. However, if the susbtitution is too large, specific nutrient defficiencies may appear thus reducing animal performance. In general, substitution effects should

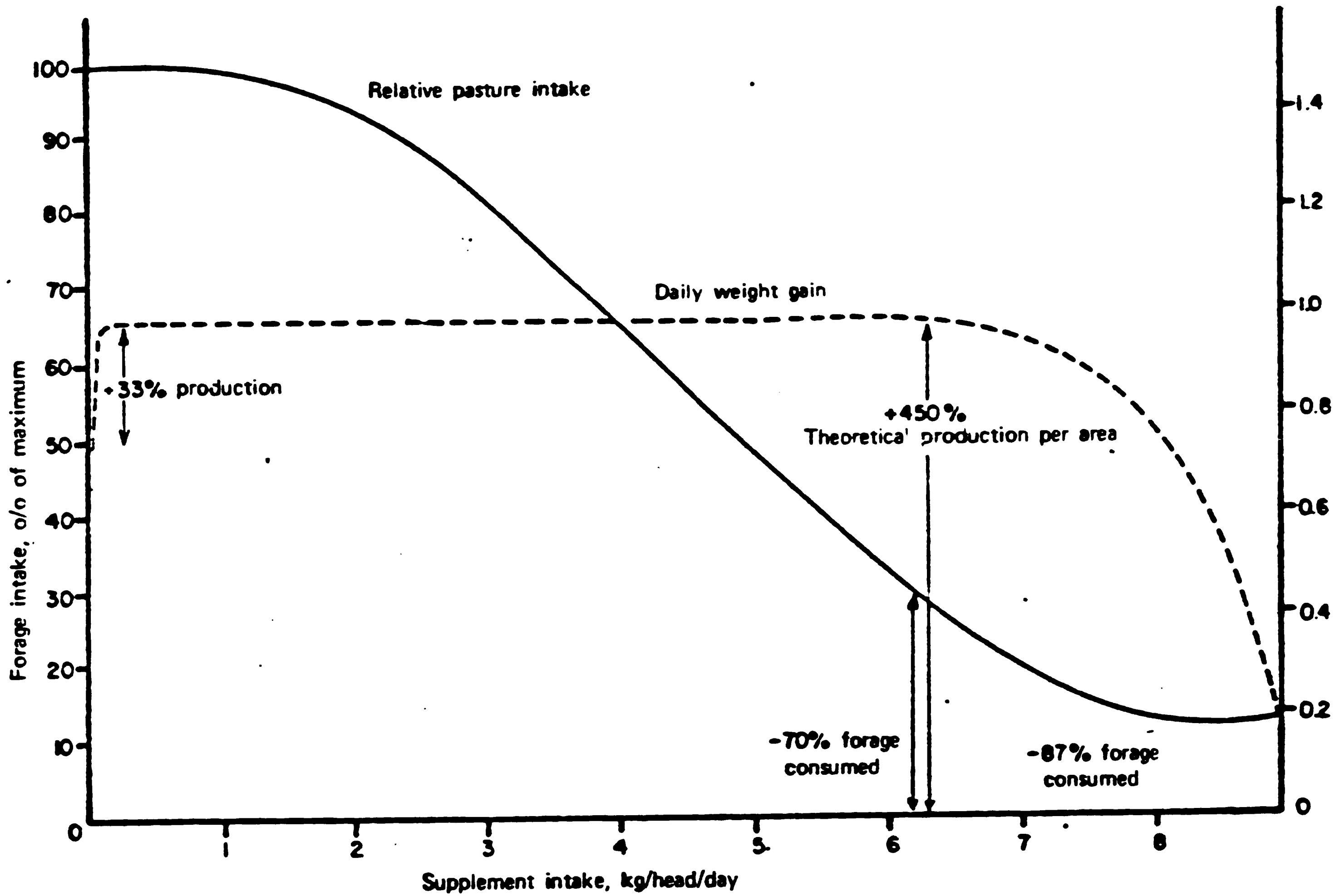


Fig. 4. GENERAL RELATIONS BETWEEN SUPPLEMENT INTAKE, FORAGE INTAKE AND WEIGHT GAIN OF GRAZING YOUNG BULLS.

be avoided since the cost of the supplement is usually higher than the cost of the forage; if this effect occurs, it can be offset by increasing the stocking rate, thus improving productivity per hectare. An example of such manipulation is offered in Table 7.

**Table 7. Maximum beef production per hectare in humid tropical pastures varying the stocking rate and level of supplementation with green bananas (4)**

| GREEN BANANAS[a/] KG/HEAD/DAY | STOCKING RATE KG/HA/DAY | WEIGHT GAIN KG/HA/YEAR |
|---|---|---|
| 0 | 1000 | 694 |
| 2.5 | 1100 | 748 |
| 5.0 | 1500 | 821 |
| 7.5 | 1850 | 949 |
| 10.0 | 2500 | 1168 |

[a/] As-fed basis, 20% DM

Clearly, there is a tremendous potential for improving beef production in tropical environments. What is needed is the building of road networks, marketing facilities, carcass grading systems, price incentives and a well-run technical assistance and credit program. No economic analyses were given because these lack significance for other countries. This is, definitely, the ultimate criterium for discerning which, if any, alternative is most appropriate to technify beef cattle production systems in tropical areas.

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