# LIVESTOCK PRODUCTION IN FEEDLOTS/LANDLESS SYSTEMS

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## Summary

Landless systems are used throughout the world, under temperate and tropical conditions as well as in developed and developing nations. The major factor determining the use of landless systems appears to be the relative cost of grains and the availability of feed byproducts. Prices of animal products are also determinants of the system used. There are advantages and disadvantages in using these systems to produce meat and milk. Landless systems allow for the use of a high input system where intensive nutritional management allows very high growth rates or milk production. Landless systems also allow the expression of production potential by superior genotypes, which is not possible under extensive, grazing conditions. The level of control of production achieved in feedlots results in the high quality and uniformity of product demanded by consumers. Several technologies, including the use of hormones and feed additives, have the potential to dramatically increase animal performance under these systems. However, the environmental implications need to be carefully evaluated. Landless systems may decrease land requirements and reduce methane emissions but the concentration of wastes creates local issues.

## 1. Introduction

Livestock supply milk, meat and fiber for human use, converting relatively low-quality feeds into high-quality products. The degree to which livestock add value to otherwise unusable feed resources depends upon the similarity of their digestive systems to our own. Therefore, species such as swine and poultry are simple-stomached animals like humans, and depend upon relatively high quality feeds to maintain high levels of production. This places them into partial competition with humans for cereal grains and oilseeds. In contrast, species such as cattle, sheep and goats are ruminants, whose compartmentalized stomachs enable them to utilize fibrous feeds that are inedible to humans. These feed resources may include pastures and rangelands, as well as many crop residues and byproducts of the food processing industries. To achieve economically viable levels of productivity, these feeds are often supplemented with cereal grains and other human-edible feeds. The proportions of these resources devoted to feedlot production depend upon market conditions, including relative prices of different feeds, meat and milk, as well as product quality specifications.

## 2. Animals

Meat production systems may be classified as intensive or extensive. Intensive systems involve management of animals in artificial environments, i.e., climatic, dietary, and disease factors are closely controlled by the producer. In temperate zones, these are exemplified by the swine and poultry industries, although some ruminant feedlots could also be considered in this category. In tropical and less-developed areas, pigs and poultry are often raised under extensive conditions, and ruminants are rarely fed cereal diets for prolonged periods. Extensive production systems require little human manipulation of the environment, so that livestock must survive, reproduce and grow under the prevailing natural conditions. Most landless systems used for ruminant production control some of the environmental conditions, while others cannot be controlled in a cost effective manner. Due to variations in latitude, altitude and meteorological factors, livestock are thus exposed to temperatures ranging from below 0°C to over 40°C, and relative humidity from 10 to 100%. Depending upon location, there is a variety of ecto- and endo-parasites that can impair performance directly or indirectly by transmitting disease. Feed availability and quality also vary tremendously among locations, within and between years. In temperate zones, livestock must cope with cold stress and low feed availability, depending on the season. In comparison, animals raised extensively in the tropics often have abundant feed of very low quality, and must deal with heat stress and more intense parasitism. Under tropical conditions, periods of relative cold weather, drought and decreased photoperiod can also decrease pasture production and feed availability. Clearly, desirable animal characteristics will vary depending on the type of production system and environmental constraints, so that no one type of animal could fit all locations and markets.



*Bos taurus* cattle, represented by the European breeds of cattle, tend to perform well in temperate environments and produce meat that is of high quality. There is significant variation among breeds as well as within breeds in growth potential and fattening characteristics, as exemplified by the difference among the medium- framed British breeds such as Angus, Hereford or Shorthorn as compared to the larger-framed continental breeds such as Charolais, Limousin and Gelbvieh. These differences also include mature size, which can be very important in determining the efficiency of the cow-calf production segment of the production system. Large-frame animals can grow faster and for a longer period of time, and thus are very efficient under the landless feedlot system. On the other hand, the larger sizes of the cows can have a great impact in reducing the efficiency of calf production (Figures 1 and 2).

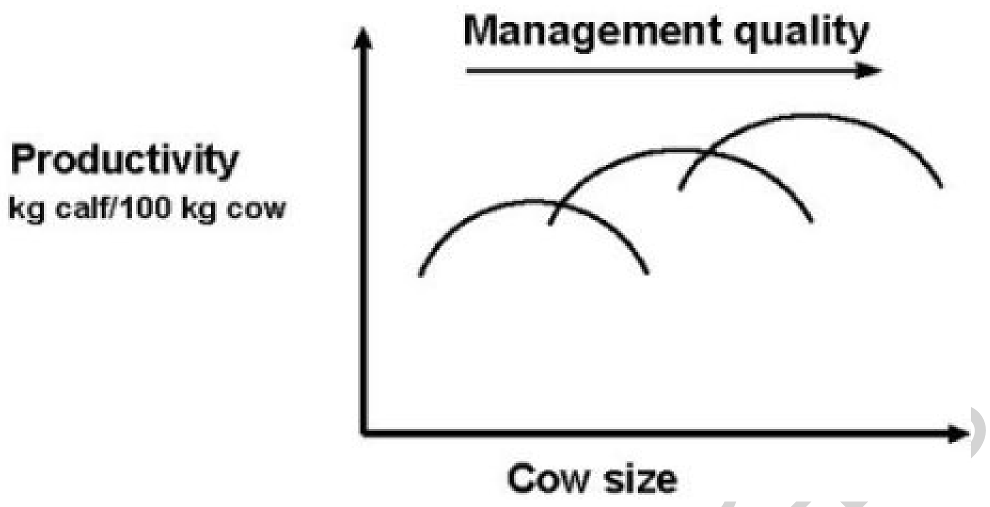


Figure 1. Possible effects of management and mature size on productivity, expressed as the weight of weaned calves relative to the weight of cows bred.

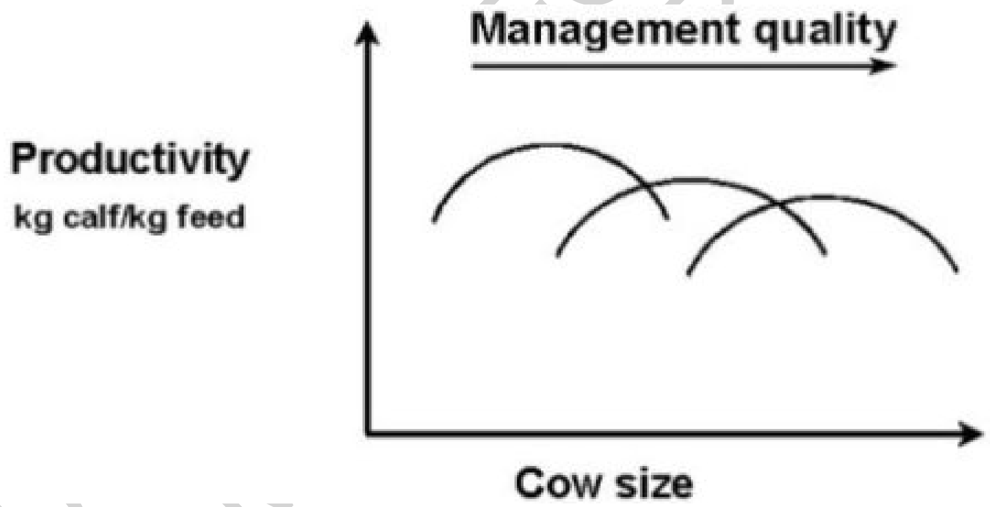


Figure 2. Possible effects of management and mature size on productivity, expressed as the weight of weaned calves relative to the feed consumed by the cow-calf pair.

Genetic differences become much more pronounced when we compare these European types of cattle, *Bos taurus* with the humped (Zebu) cattle or *Bos indicus*. Zebu cattle tend to have significant advantages in hot environments, whether they are dry or wet, as compared to *Bos taurus*. These advantages are related to their ability to dissipate heat, to withstand the higher temperatures without suffering a loss of intake and to their resistance to ecto- and endo-parasites. These advantages allow the Zebu to survive and produce in tropical environments which can be detrimental or fatal to their European cousins. The NRC guidelines include a 10 percent adjustment in maintenance requirement recognizing that Zebu cattle have a lower fasting heat production than *Bos taurus*. This lower requirement for maintenance is most important for beef cows or in systems where animals are fed for low productivity. *Bos indicus* cattle tend to have higher activities of calpastatin, an inhibitor of intracellular calcium-dependent proteases, and lower rates of protein turnover, than *Bos taurus*. Since protein turnover is energetically expensive, this is likely one of the mechanisms for the reduced maintenance requirement. Since meat tenderization depends upon post-mortem proteolysis, *Bos indicus* cattle also produce meat that is significantly tougher than that from *Bos taurus* cattle. Zebu cattle also tend to marble less than *Bos taurus*, which probably accounts for the persistence of the marbling score as the primary quality grading variable in the U.S. market, in spite of the lack of significant relationship between marbling and tenderness (Fig. 5). It should be noted that the advantage of Zebu under tropical conditions becomes a disadvantage under extreme cold, where its ability to dissipate heat rapidly and its lack of insulating sub-cutaneous fat then becomes a liability. North American producers understand that Brahman cattle in cold environments will actually require more feed. Nevertheless in the hot environments of the south and southwest of the U.S. a certain proportion of Zebu (usually between 1/4 and 3/8) is essential for survival and productivity of cattle in those environments.

Typically, beef cows depend upon native range or improved pastures for all or most of the year. They are bred to calve in either Spring or Fall, and calves are weaned at 6 to 8 months of age. After weaning, calves may go direct to a feedlot for finishing (that is, fed to market weight and fatness), they may be placed on pasture for a period prior to feeding, or they may be finished on pasture. Depending upon the management sequence, animals may thus enter the feeding phase at weights ranging from 150 to 450 kg. From this point onwards, management of feedlot cattle entails mainly the health program, the feeding program, growth manipulation, and marketing.

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**Biographical Sketches**

**Dr Sainz'** research focuses on interactions among nutrition, genetics and physiological state, as they affect growth, carcass composition and product quality. Examples include the study of lambs expressing the callipyge mutation, with marked muscle hypertrophy and decreased meat tenderness; the use of exogenous metabolic modifiers to alter the partition of nutrients; and the study of physiological, cellular and metabolic adaptations to different planes of nutrition, with particular reference to the energetics of compensatory growth. In addition, dynamic, mechanistic models of growth and metabolism are developed and used to identify critical areas of research, design appropriate experiments, and aid in interpretation of results. Simulation models are also used in support of the development of sustainable livestock production systems in temperate and tropical environments.

**Dr. Lanna's** Growth and Nutrition Laboratory at the University of São Paulo conducts research on the metabolism of nutrients for growth and lactation, with emphasis on ruminants. The research attempts to understand the regulation of adipose tissue deposition in growing animals and the regulation of lipid synthesis by the mammary gland. Cellular and molecular approaches are used to unravel the effects of nutrients and hormones. Current research tries to predict and manipulate body (growth) and milk composition using endogenous and exogenous hormones as well as metabolically active nutrients to improve its value to consumers. In addition there are in vivo studies on the energetics of growth and lactation in ruminants, and these experiments are linked to the development of computer models that simulate nutrient use. Such computer models are used for both research and practical applications. Models that simulate growth have been developed for beef cattle under tropical conditions and are used throughout Latin America for estimation of nutrient requirements and optimization of feeding programs.