BEEF CATTLE
&
WATER BUFFALO PRODUCTION

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UWI
MOUNT HOPE

AN INTRODUCTION TO RUMINANT PRODUCTION SYSTEMS

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Beef Cattle and Water Buffalo Production in the Tropics

1 Welcome

1.1 Introduction

Welcome to our discussion on Beef Cattle Production in the Tropics! This module contains:

⇒ Breeds and Breeding of Beef Cattle

⇒ Production Systems for Beef Cattle

⇒ Beef Cattle Health Care

The objectives of this module are to provide you with a brief discussion of how to raise beef cattle in the tropics. Beef cattle are, of course, similar to dairy cattle in many respects. Therefore in order to avoid repetition, you will be referred to the module on dairy cattle on matters in which the information is shared.

1.2 Learning Objectives

The Learning Objectives of the module are for you to be able to identify the various breeds of beef cattle suitable for rearing in the tropics. You will learn how to rear them by applying the knowledge you gain from this module.

The Learning Objectives of this Unit are:

<u>Breeds and Breeding</u>

- Ü to be able to identify the various breeds of beef cattle;
- Ü to be able to identify and describe the various external features of a beef type animal;
- Ü to be able to describe the selection and breeding principles of successful beef cattle production;
- Ü to be able to describe selection systems, methods, traits and practices for beef cattle;
- Ü to be able to describe Mating Systems;
- Ü to be able to explain an Annual Calendar of Activities for a closed herd system;
- Ü to be able to describe Herd Management and Reproduction.

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Production Systems of Beef Cattle

- Ü to be able to describe beef cattle production systems;
  - Range Management Systems
  - Semi-Intensive Systems
  - Feedlot Production
- Ü to be able to describe the management of the Breeding Herd;
- Ü to be able to describe Herd Organization.

Health and Target Performance Coefficients

- Ü to be able to relate the health of beef cattle to that of dairy cattle;
- Ü to be able to understand the target performance coefficients for beef cattle production.

The beef cattle industry represents only one source of meat. Therefore, it has to compete against other sources, such as goats, sheep, pigs, poultry and dairy cattle culls for the consumer's dollar. In many tropical countries Dairy Cattle Culls [bulls, heifers and old cows are important sources of fresh beef]. The price of beef must, therefore, be competitive relative to the price of these other meats. We can only attain this goal by improving the efficiency of the beef cattle industry. But the economics of beef production from cattle is outside the scope of this course, and this would have to be covered in the course on Agricultural Economics and Farm Management.

The improvement of efficiency through management with emphasis on breeding must be considered as a necessary on-going feature in any cattle production system. In fact, this is important in any animal production enterprise. Beef cattle are able to convert roughage into valuable animal protein and can utilize marginal lands which would other wise lay idle and unproductive. The beef animal theoretically, may not be the most efficient converter of grass to animal protein but remains the animal of choice in certain circumstances. These circumstances may arise when and where land may be cheap or available, where there may be an abundance of forage and / by product feed resources for feeding to ruminants. In the Caribbean Beef Cattle production is important in Cuba, Jamaica, the Guyanas [English, Dutch and French speaking], The Dominican republic and to some extent Trinidad and Tobago.

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1.3 Why Beef Cattle?

Let's explore some of the reasons for raising beef cattle.

- Ü They require a small investment in buildings and equipment [except the intensive feedlot system];
- Ü Are efficient users of labor;
- Ü Have lower mortality [mortality rates are higher among calves and yearlings than mature cattle];
- Ü Beef is a popular source of human food;
- Ü Manure is a valuable by-product of beef cattle rearing;
- Ü In the Caribbean we need to emphasize clean and healthy beef for our important Tourism Industry.

Some Components of the Beef Industry

Three main components of the industry are:

- Ü The purebred breeder
- Ü The commercial producer
- Ü The feeder or feeder operation [sometimes called the "Opportunity Feedlot".

At the end of this module, you should have a good appreciation of Beef Cattle Production.

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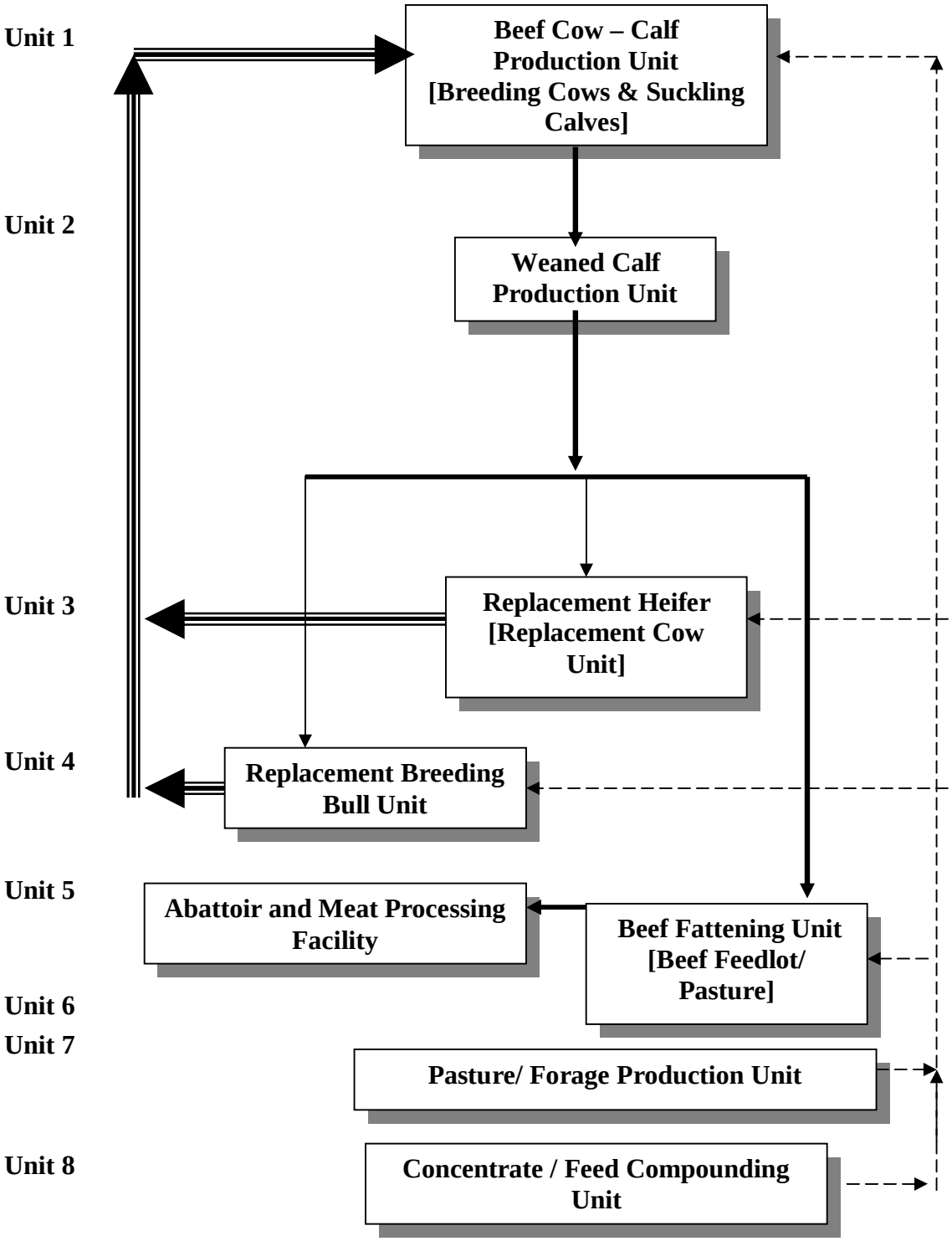
Figure 1: Beef Cattle Production Units Industry Process Flow



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2 Breeds and Breeding

Quick Start h

Let us begin by presenting you with the external body parts of beef cattle.

Figure 2 Body parts of Beef Cattle

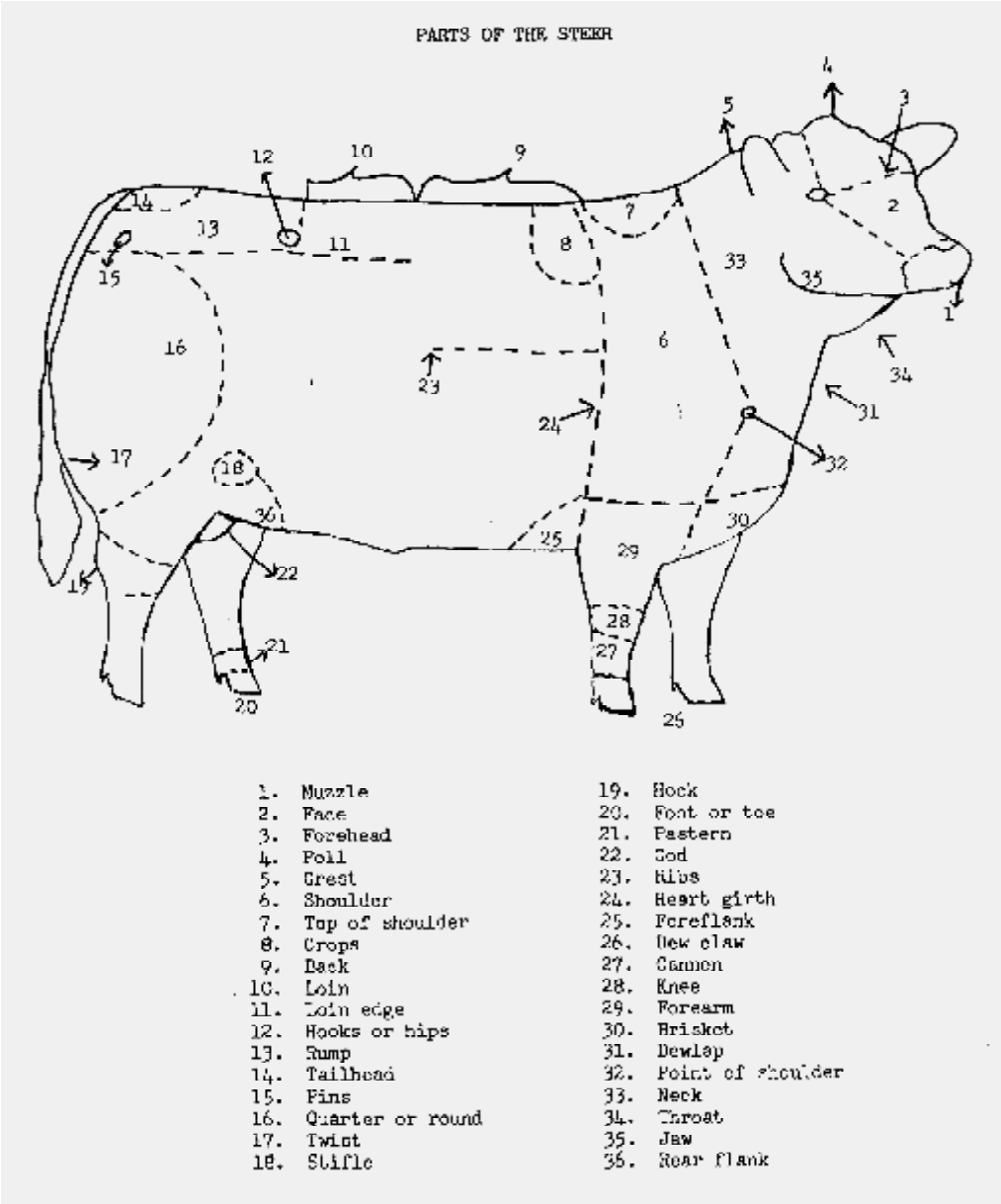

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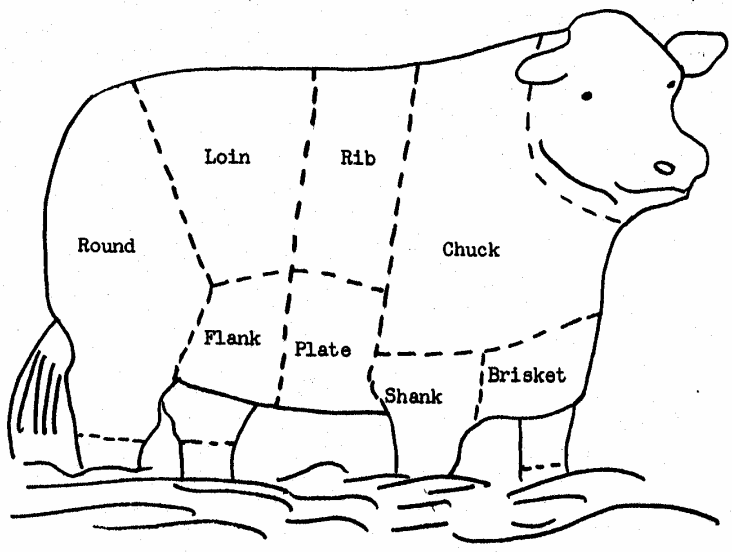
Figure #3: Wholesale Cuts of Beef



	% of Carcass Weight	% of Total Carcass Value
Round*	24	29
Loin*	17	29
Rib*	9	11
Chuck	25	21
Brisket	6	4
Shank	4	1.5
Plate	8	2.5
Flank	4	1.5
Kidney knob	3	0.5

*Round, loin and rib together account for 50% of carcass weight and about 70% of carcass value.

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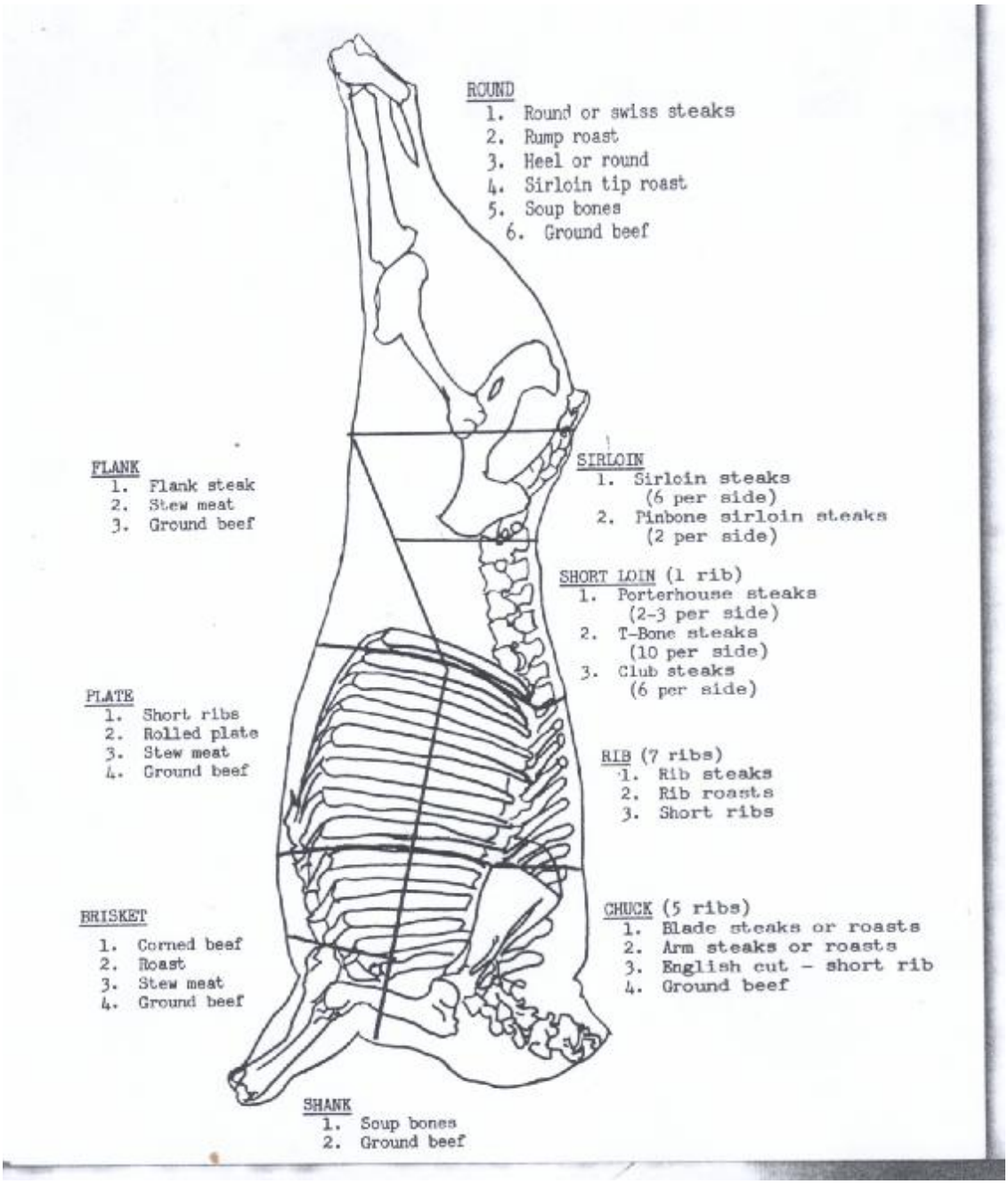
Figure #4: Breakdown of Beef Carcass Cuts



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The Lesson /

The breeding of purebred beef cattle has been an ongoing practice world-wide. The popular breeds available in the Caribbean will be first presented.

2.1 Breeds

In the Caribbean our purebred breeds of beef cattle are:

2.1.1 The Jamaica Red Poll

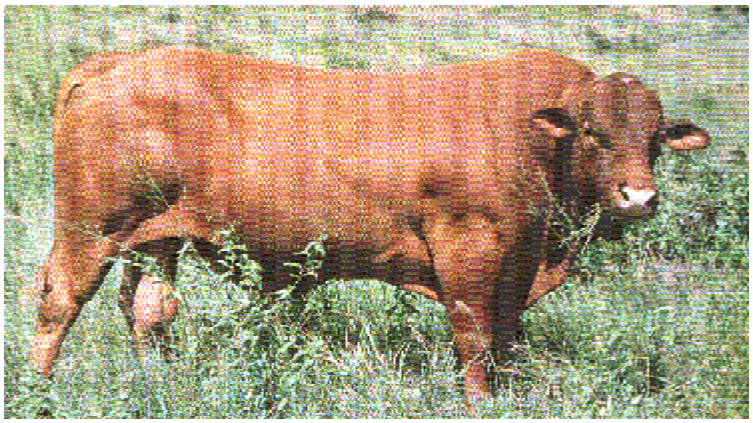

Figure #5: Red Pole Bull [Note the absence of Horns, hence they are called "polled]

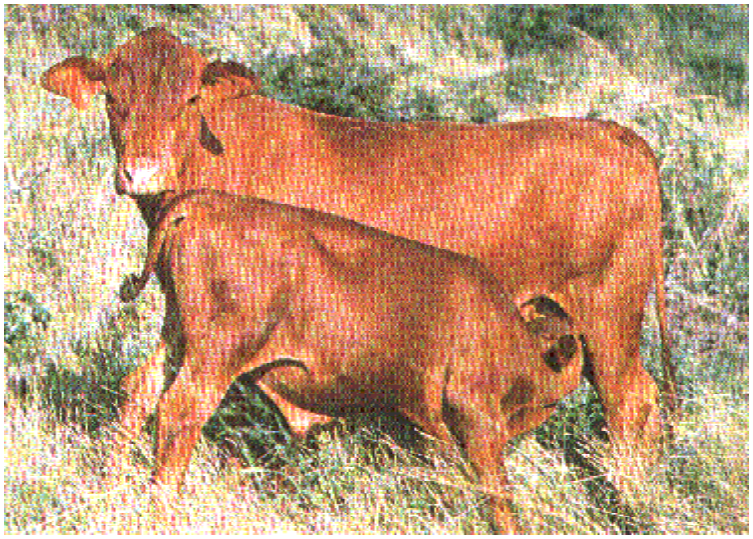

Figure #6: Red Pole Cow and Calf [Note the absence of Horns, hence they are called "polled]

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2.1.2 Jamaica Brahman

Figure #7: Jamaican Brahman Bull

2.1.3 Jamaica Black

Figure #8: Jamaican Black Bull

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2.1.4 Zebu or Brahman

Figure #9: Jamaican Brahman / Zebu Bull

2.1.5 Culled Dairy Bulls as a source of Beef

2.1.6 Croillo

You may also see some other breeds, such as Santa Gertrudis, Hereford and Charolais in tropical regions. The Charbrais [a cross between the Charolais and the Brahman (Zebu) cattle] have proven themselves quite useful in the Tropics.

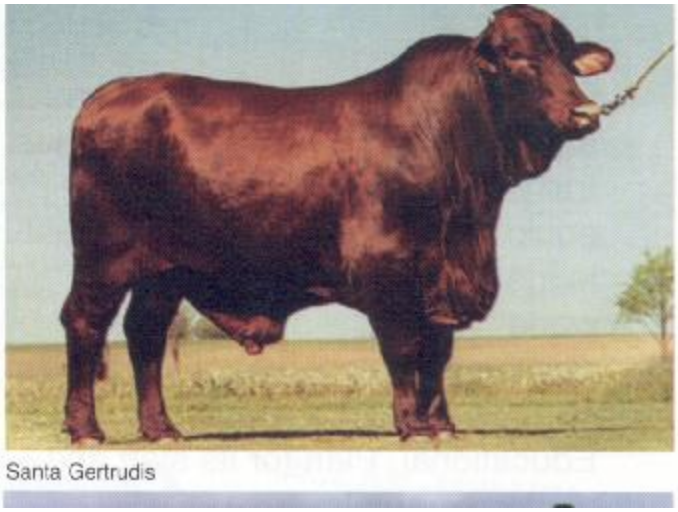

Figure #10: Santa Gertrudis Bull

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Table 1 : Description, origin and production characteristics of Beef Cattle Breeds.

Breed	Colour	Horned or polled condition	Origin
1. Major Breeds			
Angus	Black	Polled	Scotland
Beefmaster	Red and White	Horned	U.S.A
Brahman	White to Grey	Horned	India
Brangus	Black	Polled	U.S.A
Cjarolais	White	Both	France
Charolais	White	Horned	Italy
Gelbvieh	Shades of yellow	Horned	Germany
Hereford	Red body, white extremities	Horned	England
Limousin	Golden Red	Horned	France
Polled Hereford	Red body, white extremities	Polled	U.S.A
Red Angus	Red	Polled	U.S.A
Salers	Red	Horned	France
Santa Gertrudis	Dark Red	Horned	U.S.A
Shorthorn	Red, White or Roan	Both	England
Simmental	Red and White	Horned	Switzerland
2. Minor Breeds			
Blonde d'Aquitaine	Solid yellow-brown, fawn or wheat	Horned	France
Brown Swiss	Shades of brown	Horned	Switzerland
Devon	Red	Horned	England
Fleckvieh	Red and White	Horned	Germany
Galloway	Black	Polled	Scotland
Hays Converter	Black and White	Horned	Canada
Holstein	Black and White	Horned	Holland
Lincoln Red	Red	Both	England
Maine-Marie-Anjou	Red and White	Horned	France
Marchigiana	White	Horned	Italy
Murray Grey	Shade of silver-grey	Polled	Australia
Normande	Red and White, some black, brown, blonde and white	Horned	France
Pinzgauer	Chestnut brown with white topline, belly, thighs, elbows and brisket	Horned	Austria
Red Poll	Red	Polled	England
South Devon	Red	Horned	England
Welsh Black	Black	Horned	England

Source: Adapted from Brant and Kenealy (1994).

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2.1.7 Other Beef Cattle Breeds

The previous table presented to you the more popular breed of beef cattle available in North America, South America and Europe.

2.2 Selection and Breeding

2.2.1 Breed Selection Principles

The choice of any breed in animal production systems depends to a large degree on its adaptability to the environment and its productivity. The purebred animal offers stock of high quality for economic beef production both for seedstock producers and commercial producers. Opportunity for genetically improving economic traits rests primarily with the purebred breeder, the opportunity for selection being higher among bulls. It is important that you have some knowledge and understanding of measures to evaluate these traits, along with your adoption of effective breeding practices. The variation among animals in the phenotypic (external or physical) expression of any trait results from genetic differences transmitted from their parents and environmental differences in which they develop.

In general, each animal receives half its inheritance from its sire (father), and half from its dam (mother). In this process of gene segregation (halving) and recombination to form an individual animal, it is strictly a matter of chance that one offspring will receive a more desirable complement of genes for economically important traits than another. This is the main cause of **variation**. A large number of individuals will show genetic merit which will be the average of that of their parents, however, some will be genetically inferior to the average of their parents.

Those that are *superior* provide the opportunity for selection. Selection permits some animals to leave a greater number of offspring than others.

GOAL OF SELECTION:

The object of selection is to increase the number and frequency of desirable genes affecting a trait. This is accomplished by selecting animals above the herd average in genetic merit for that trait.

The breeding merit of an individual animal is seldom evaluated by a single trait, but more often on the basis of several traits. Most traits of economic importance are controlled by many genes. Culling animals poor in economic traits, therefore, reduces the number or frequency of undesirable genes.

2.2.2 Selection Parameters

Some factors to be considered when using selection as a means of improving productivity are:

Ü **The heritability of the trait *(h)*** (that is a measure of the likelihood of the trait being transmitted from parent to offspring)

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- **The genetic correlation among the traits being selected for *(r)*** (that is, the degree of association among genes which influence both characters)
- **The selection differential being practiced *(s)*** (that is, the difference between the selected individuals and the average of the group from which they were selected)
- **The generation interval *(t)*** (that is the average age of all parents when their progeny are born)

You can calculate genetic progress on an annual basis (progress per year) from the following equation:

$$\text{Genetic Progress} = \frac{\text{heritability x selection differential}}{\text{generation interval}}$$

Now look carefully at this equation. Do you see that progress can be greater if the generation interval is shortened? [This is the reason why genetic progress is easily made wit h species with short generation intervals e.g. chickens and pigs]. This is largely accompanied by rigorous culling of cows on the basis of production performance.

Selection is usually aimed at improving the animal's total value.

Selection can only be successful where genetic differences can be measured. In order to measure genetic differences the environment must be made as uniform as possible. Cattle must therefore be compared at the same age, period of time and under the same environmental conditions, unless adjustments are made for any known differences.

The following table presents the selection traits for beef cattle with their desired respectful goals and h^2 values.

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Selection Traits for Beef Cattle

Trait	Goal	h^2 (%)
Reproductive		
percent calf crop (herd basis), %	95	5-15
cow size, lb.	1100-1200	5-15
Productive		
birth weight, lb.	70-100	30-40
milk yield per day, lb.	15-25	20-30
weaning weight, lb.	600	15-25
post-weaning daily gain, lb.	3.0	50-55
feed efficiency, lb. feed/lb. gain	6.5	40-50
yearling weight, lb.	1100	40-50
Qualitative		
carcass weight per day of age, lb.	1.8	40-50
backfat thickness, in	0.4	40-50
backfat thickness/cwt., in	0.07	40-50
loin eye area, sq. in	2.00	50-60
yield grade	2.0	50-60
quality grade	Choice	50-60

There are **four [4] main systems of selection** and **three [3] main methods of selection**.

2.2.3 Selection Systems

There are various selection systems available which may be used individually or in combination:

Ü **Pedigree Information:** This system of selection is useful in selecting young animals before their own or their progenies' performance is known. It can also be used for traits measured late in life or expressed only in one sex. The pedigree is the known information on their parents and grand parents.

Ü **Individual Performance:** Mass selection produces rapid improvement in traits of high heritability and permits rapid turnover of generations.

Ü **Progeny Test:** This is the most accurate selection method as it is useful for traits of low heritability. This method usually results in an increase in the generation interval and requires a large number of progeny for an accurate test.

Ü **A combination of all three:** You make an initial selection is on pedigree, while later in the animal's life you may make a selection on the basis of the individual

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animal's performance information. Further use and final selection is then based on the progeny test (particularly in choosing purebred breeding stock for the next generation of breeders) .

2.2.4 Selection Methods

You can employ various selection methods with the selection system you choose:

Ü **Tandem Selection:** Involves the selection for one trait at a time to be given primary emphasis until the required level of performance is achieved. Then a second trait is worked on, and so on.

Ü **Independent Culling Levels:** A specific (usually minimum) phenotypic value is set for each animal. Only the animals which reach these values in all traits are selected.

Ü **Index of Net Merit (Selection Index):** A weight (significance) is assigned to each trait selected. This weight is based on the economic value, heritability and correlation among the traits. The component traits are combined together into a single score, namely, the index.

2.2.5 Traits for Selecting Beef Cattle

There are several traits which influence performance. The major performance traits of beef cattle which influence production efficiency are:

Ü **Reproductive Performance and Fertility:** Both males and females must be considered. Sires must be selected from cows with good fertility records and bulls with high fertility. Remember, this trait will also be affected by the animal's nutritional status.

Ü **Mothering ability:** You use the weaning weight of the calf as a measure of this trait. The ability to wean heavy, vigorous calves is necessary for an efficient cow-calf operation. Increasing amount of pounds of calf produced per cow increases efficiency. Selecting bulls and replacement heifers with heavy weaning weights relative to your herd average will lead to genetic improvement in mothering ability.

Ü **Growth rate:** There is a high association with economy of gain measured in two main phases:

1. Pre-weaning weight
2. Post-weaning weight

Ü **Efficiency of gain:** This trait is based on the amount of increase of liveweight of the animal per unit of feed fed (liveweight increase per unit of feed - Feed Conversion Efficiency). The trait is selected based on pounds on the basis of the rate of gain.

Ü **Longevity:** A longer productive herd life reduces your cost of replacements but increases generation interval. This leads to a decline in rate of improvement from selection, but you must strike a balance. This trait is affected by fertility and the structural condition of the animal's feet and legs.

Ü **Carcass merit** (*i. e.,* the fat, lean and bone composition of the carcass): Carcass merit is indicated by conformation traits. Maximum muscle development occurs

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in the areas of the back, loin, rump and round. Selecting animals which will reach desirable market weights at a younger age usually results in a higher lean-to-fat-to-bone ratio.

2.2.6 Breeding Practices

The number of females that can be successfully bred by a single bull is dependent on his age, nutritional status and the herd management practice.

Semi-Intensive Management Systems

In semi-intensive management systems, breeding herd size ranges from 20 to 40 cows, requiring 1 to 2 bulls per herd.

Range Management Systems

For range management herd size is usually over 40 and bull numbers vary, from 2 and over.

A general rule of thumb for bull : cow ratio is 1 mature bull to 30 females (1:30).

- A young bull, 2-1/2 to 3 years old, should not be allowed more than 15 to 20 females;
- Bulls 3 to 4-1/2 years old, may be allowed 20 to 30 females; and
- Mature bulls may be allowed 30 to 40 females.

As herd size increases, you should provide more bulls relative to the number of cows.

In the tropical environment, usually you will breed your heifers by weight rather than age. A breeding weight of 65 to 75% of mature body weight or a minimum 600 lbs. (273 kg) liveweight is desirable. At the same time, you should recognise that this weight should be attained between 20 to 27 months, to achieve the production target age at first calving of 36 months. The time of the breeding season, usually depends on when you, the farmer, wants your calves to be born, either for environmental or marketing reasons or both.

Generally, the calving season should begin before the period of the best quality and quantity of forage production. In this way, your calves will be able to utilize the increased milk production of the cow. You should plan the breeding season to take advantage of the increased quality and quantity of forage.

There are two main categories in describing breeding practices: closed and open.

- **Closed or Seasonal Breeding:** The practice of restricting animals to one specific time period of weeks is called seasonal or closed breeding. You check the herd's pregnancy status after the end of the season and calves are born over a limited time period.

Advantages

Some advantages of seasonal breeding over year-round breeding are:

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- Reduced labour cost
- Reduced numbers of farm hands required
- Calves are easily weaned, branded, medicated at the same time
- Sale of calves can be easily regulated by breeder
- Reduced mortality rates in both cow and calf
- Weaning weights on average are usually higher
- Greater control over feed requirement and production
- Calving percentages are usually higher
- Bulls remain in better condition

Disadvantages

Some disadvantages are:

- Cost of erecting and maintaining bull paddocks for resting bulls
- A few more bulls may be required on the farm

For seasonal breeding, bulls should be removed from the pastures within 2 to 3 months after the beginning of the breeding season. A breeding season of 65 days or more gives most cows in the herd three (3) opportunities to conceive.

Pregnancy tests six weeks after the end of the breeding season will reveal open females (non-pregnant females) which should be culled, especially if previous production was poor. A short controlled breeding season usually predisposes the calf crop to greater uniformity at weaning and better more organized calf management techniques could be employed.

- **Open or year round breeding** involves running the bull with the herd all year. Calves are born throughout the year and usually, manpower requirements cannot be well administered. Bimonthly pregnancy checks are required so as to help early planning for calving.

2.3 Mating Systems

In general there are three (3) methods of mating:

2.3.1 Hand Mating

With hand mating, the bull is kept separate from the cow herd and the cow is put to the bull when observed on heat and remains with the bull until she is served.

2.3.2 Pasture Mating

With pasture mating, you allow the bull to run with the breeding herd throughout the season. This method saves labour, as the bulls usually identify cows in heat.

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2.3.3 Artificial Insemination

Artificial Insemination is not very widely practiced in beef cattle but its advantages have been recognized. You can use the semen of outstanding performance tested bulls to many cows. Conception rates are usually lower, but the method prolongs the usefulness of valuable sires.

Mating systems are classified on the basis of how much outbreeding or inbreeding is involved.

Outbreeding is the most common mating system practiced in beef cattle and it involves the mating of individuals that are the least closely related in the population or breed from which they originate.

Line breeding is the practice of mating animals who have a common ancestor. The aim is to concentrate the desirable genes of that ancestor into present and future generations. This makes animals more uniform and therefore more predictable in performance. This mating system is usually only practiced by seedstock breeders who maintain in-depth herd records.

2.4 Annual Calendar of Activities in a Closed Herd System

Table 2 is an example of a calendar of breeding events in a year of the cow-calf operator in Jamaica. Remember to bear in mind those factors which determine the optional breeding and calving period for your situation.

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Table 2. Annual Calendar in a Closed Herd System for Jamaica

MONTH	*ACTIVITIES*
January (dry season)	**Cows calving through to March, check cows frequently. Put heifers into breeding herd.**
February (dry season)	Continue to check cows frequently identifying calves, etc. Check calves for navel problems. Do breeding soundness. Evaluation of bulls.
March (dry season)	Continue to check cows and record calves. Breeding season begins March 25 through June 20.
April (dry season)	**Put bulls in herds for first five weeks (single sire herds)** **Multiple sire herds, all bulls on.**
May (dry season)	Exercise good pasture management. Be sure mineral supplements are available. Breeding season continues. Remove first set of bulls on single sire herds. Bulls may be allowed to remain, but watch for disinterest in cows.
June (wet season)	Second group of bulls put on for five weeks. Breeding season continues.
July (wet season)	**Exercise good pasture management.** **Make note of promising calves, male and female. Number of females selected should be about 20% more than required.**
August (wet season)	Check and repair weaning pens.
September (wet season)	Wean January born calves. Deworm and vaccinate. Select male and female replacements. Sell culls. Make sure weaned calves and their mothers stay separated. Check cows for pregnancy. Examine breeding herds. Open cows should be culled. Check condition of first-calf heifers.
October (wet season)	Wean February born calves. Select replacements, following procedure above. Bull calves, if kept, should be put on test.
November (wet season)	Finish weaning calves. Select replacements as above.
December (wet season)	Female calves should be run with heifer herd.

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2.5 Herd Management and Reproduction

2.5.1 Factors Affecting Herd Fertility and Fertility Improvement Measures

Reproductive performance is one of the most important and complex traits in beef cattle. Improving this trait is a prime goal of the producer. A high level of fertility is fundamental to efficient production and genetic improvement. This trait is considerably influenced by environmental conditions and you should pay close attention to herd management especially in terms of feeding and disease control. Fertility may be low because of failure to conceive, or cows coming in heat late in the breeding season.

Fertility must be addressed in terms of the bull, the cow and the heifer. You should evaluate bulls prior to putting them in the herd. Your cows and heifers should be in good condition in terms of flesh cover prior to the season.

Ü **Number of calves per year** - The beef cow is expected to produce one calf per-year. Out of the 365 day year, she is pregnant for about 284 days. Of the remaining 81 days she is unlikely to return to heat until 40 to 60 days after calving. This only leaves between 21to 41 days for her to become pregnant. Her body condition is therefore critical, so as to optimize this period and to reduce the period of *post partum* return to heat.

Ü **Nutrition** - Nutrition, especially in terms of energy content, may be a critical factor in maintaining fertility levels. At the time of breeding, the cow has to deal with both lactation and normal reproductive function. For the heifer, energy must be provided for both growth and reproduction functions .

Ü **Bull to Cow ratio** - Another management factor affecting fertility is the bull to cow ratio. Low calving percentages result because cows in heat do not have access to a bull before they go off heat. This may be due to too few bulls running with the cows. Bulls should be placed under pasture conditions similar to those in which they will run with cows, at least six months to a year before they are needed.

Ü **Diseases** - Fertility may also be reduced as a result of specific diseases. Three such are brucellosis, leptospirosis and fibrosis. Veterinary checks and advice are required to eliminate or control these disease.

Once the level of management has been improved, culling infertile animals can increase fertility levels. Some reproductive parameters that can be used to assess reproductive performance are listed below.

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Table 3: Reproductive Performance Parameters of Beef Cattle in the Tropics [This is very important !]

Parameter	Range
Age at first calving	34-36 (months)
Calving interval	12-13 (months)
Conception rate (pregnancy rate)	90%
Calving percentage (birth rate)	88
Weaning percentage (% calf crop)	85
Percent herd culled for sub-fertility	5
Days open	50 to 90 days
Length of calving season	90 days

It should be noted that the Jamaica Red Poll has been ale to achieve and surpass some of these parameters (Karl Wellington).

2.5.2 Measures to Improve Herd Fertility

There are a number of measures you can take to improve your herd fertility. You could:

- Improve the nutrition of your heifers and cows
- Maintain bull to cow ratios between 1:15 and 1:25
- Evaluate your bulls prior to breeding season
- Wean your calves from cows at seven to eight months of age

2.5.3 Selection and Management of Herd Sires

One of the most important decisions you have to make in beef cattle management is the selection of the herd bull. A herd bull must sire calves (for an extended period of time) that are in demand as breeding stock, as well as for feeding and slaughter. He can affect the calving percentage as well as the quality of calf. Before selecting the bull, first check the cow herd. He should be from a cow which is superior to your top cows.

Type

Selection of the right bull starts first with type. A bull should be good from end to end, be physically sound and should be especially strong in desirable traits which may be lacking in the cow herd. He should be active, vigorous and mild tempered. Care must be taken to assess his feet and legs for structural soundness.

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Productivity

Productivity is the next important criterion in selecting a bull. The animla's weaning weight, rate of gain and economy of gain are important production traits. Bulls are usually available directly from seedstock producers. Records of performance should be assessed and type evaluation done in conjunction with an experienced breeder.

All breeders should be on the alert for hereditary defects. Herd histories are therefore important. The dam of the bull should be a cow with a record of regular calvings and heavy milk production (or good calf weaning weights).

The management of the herd sire technically starts from birth, but most potential sires will be identified by weaning. Calves that show promise require your special attention post weaning. They should be put on performance test and fed a well balanced ration to permit it to express its growth potential. On completion of the test, you should feed and manage the selected bull so that normal growth is attained and maintained.

For sires bought as yearlings or older, evidence of beefiness must be apparent. He should be moderately wide and deep, indicating good muscling. He should show strong development in the hind quarters. His forelegs should be straight, strongly placed and set to accommodate the shoulders, while hindlegs should neither be too straight nor sickle-hocked.

A bull must look like a bull. He should be masculine from head through to forequarter. Herd sires on rest should be maintained in good condition. Adequate exercise is a necessity to maintain condition. Feet should be checked frequently and trimmed if necessary.

2.5.4 Selection and Management of Herd Replacements

Cows are removed from the herd at regular intervals for reasons of sterility, injury, disease and old age. But the longer cows remain productive in the herd, the fewer replacements will be needed. The cow must be assessed on her productivity in terms of number of calves weaned, and weight at weaning. Most cows will produce their heaviest calves between the age of 5 to 10 years of age peaking at about age 5 to 7 years. At about 10 to 11 years calf weaning weights begin to decline.

The replacement heifer must be viewed as being able to contribute a little more than the cow she is replacing. Foremost, heifers must be selected out of top cows, their dams being regular-breeding heavy-milking beef cows. She should be above herd average in terms of weaning, growth and thriftiness. She should be serviceable and have an udder of good texture. Seedstock breeders should select heifers representative of their breed. You should keep or buy a surplus of about 20% of the number required as replacements.

Heifers go through three selection stages:

1. At weaning, based on type and weaning weight
2. At 18 months of age
3. After weaning their first calf

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About 10% are culled at 18 months based on weight per-day-of-age and type. The final 10% are culled on the basis of weaning weight of their calf.

Heifers should be fed so as to allow for at least 1 lb (0.45 kg) of gain per day from weaning. They should be dewormed at regular intervals otherwise you will end up culling animals due to your negligent management.

2.5.5 The Role of Crossbreeding in Improving Beef Production Efficiency

Crossbreeding is the breeding of a bull of one breed with a cow of another breed.

Why should you crossbreed?

- To take advantage of the combining ability of the good qualities of the two breeds.
- To utilise the effects of hybrid vigour or heterosis [**define]** in traits related to physical fitness and vigour. Crossbreeds have increased fertility and livability, increased weight gains in early life, reduced death loss at calving, improved carcass quality and quantity.
- Cross bred heifers reach puberty at a younger age, and therefore remain productive in the herd for a longer time.
- Crossbreeding increases efficiency in beef production through the raising of larger numbers and heavier calves at weaning, which result in heavier weights at the end of the fattening period.

As with seedstock breeding (i.e. breeding of future breeding stock), breeding stock used for crossbreeding should be carefully selected and breeding systems practised, so as to optimally use combining ability and heterosis.

Heterosis:	The effect observed from the offspring of the first generation from crossing two breeds or distant lines. The improvement is more than just the **additive effects of the two parents, i.e. better than the average performance of the two parents**

Crossbreeding for beef includes both beef cross and dairy-beef crosses. Some dairy breeds possess and transmit genetically rapid growth rate, large mature size, more lean and less fat at slaughter, and a high rate of milk production. All traits which are desirable for your beef production.

A greater advantage seems achievable by crossing purebred sires of one breed with crossbred females from different breed sources.

The choice of the crossbreeding method is fairly subjective and is dependent on the market. A systematic system of crossbreeding must be planned and followed. For small herds, a two-bred backcross or crisscross system may be applicable. For larger herds, a three breed sire rotation can be used.

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- **The breed of the sire should be one that possesses and transmits rapid and efficient gains**
- **The breed of the cow should possess the kind of inheritance that will cause them to be excellent mothers of high milk production**.

Many types of crossbreeding methods can be distinguished, three are discussed below.

Ü **Single two-way crosses** is where two different populations (breed, strains) can be crossed to produce an F, generation which is not used for breeding, but rather for production. This method requires that a relatively large number of the parental types be maintained in order to continue the crossing.

Example

Breed A x Breed B = F_1 AB used for production

Ü **Three-way crosses** is where the F_1 crossbred females from matings above are crossed with males of a third breed or strain, thereby utilizing the hybrid vigor of the dams.

Example

Breed A x Breed B = F_1 AB (female) x Breed C =

ABC used for production

Ü **Rotational crossbreeding** is where crossbred females are mated with males from either of the parent population alternated (rotated) for each new generation.

Example

Breed A x Breed B = F_1 AB (female) x A =

AB.A (female) x B =

AB.A.B (female) x A used for production

Crossbreeding may seem to involve extra time and expense in locating high quality bulls of different breeds, but careful, planned culling, selection and management will ensure a sound programme on the farm.

Do's & Don'ts!

-Do not expect to get good performance from the offspring of poor Parent Stock.

-Good Breeding and Selection is not a substitute for poor management and nutrition.

-The only way that the potential genetic expression of an individual animal could be observed or obtained is after the animal has been exposed to proper Nutrition and Environmental Management.

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Conclusion

In this unit you were exposed to some more popular breeds of beef cattle in the Caribbean and Central America. Selection and Breeding Principles were introduced to you which are of importance to beef cattle. Mating Systems were introduced, and you saw an Annual Calendar for a Closed Herd System in Jamaica; and you were asked to do one for a country of your choice. You were also exposed to the importance of Reproduction in the Herd, and the desired reproductive performance parameters were identified. Finally, you were exposed to Herd Management methods used to improve Herd Fertility, and to cross-breeding methods.

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3 Production Systems for Beef

Quick Start h

There are various systems of production which may be associated with cattle used for beef production.

The learning objective of this unit will be to focus on the three conventional beef production systems [Rangeland, Semi-intensive and Intensive or Feedlot]. Beef cattle productivity must be thought of in terms of:

- Production per hectare [kg liveweight produced/animal /year]
- Production per animal unit
- Production per unit capital investment.

Productivity per hectare and per animal unit is dependent on many factors, two such are:

- The type and amount of pasture land available
- Other sources of feed and their cost.

Productivity per unit capital invested will mainly depend on:

- Cost of labor and other inputs
- The market for products of the industry.

Most of the discussions here will concentrate on the two former factors.

The Lesson /

The success of your livestock operation will be directly dependent upon the availability of abundant quantities of feed at the time when you need it. Pasture land provides the main source of feed in beef cattle production systems. Assigned areas of permanent pasture are indispensable to good animal management.

Under pasture conditions large amounts of nutrients are recycled. Pasture productivity can be measured by the annual output of animal products:

- Live weight gains or losses
- Reproducibility

Land areas too rugged to be mechanically ploughed should be kept in grasses which are both drought resistant and productive. Pastures can be divided into two main groups;

- **Native pastures** consisting of unimproved forage species, and
- **Improved pastures** consisting of high yielding selected forage species.

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Native pastures can provide part of the feed requirement for the breeding herd when improved pastures or supplemental feed are also available. Improved pastures require less acreage per animal and can result in greater weight gains of cows and calves, along with higher calf weaning percentages. The type and amount of pasture land available affects the carrying capacity [number of animals/unit area/year] and, therefore, stocking rate [number of animal units/unit area] applied.

Carrying capacity will vary with soil fertility, moisture conditions, pasture species and management. Increasing stocking rate to optimal (*i.e.*, carrying capacity) will result in greater production but production per cow unit will be reduced. Beyond optimal, overstocking results in the reduction in production per unit of land and per cow unit. Understocking will result in lower incomes per unit of land and the waste of feed produced.[Please refer to Module 5: Unit 8 to see how this actually works in a dairy situation.]

There should be ample feed for the cattle at all times. Stocking rate is therefore subjective and can be gleaned from perusing pasture species and estimating productivity under prevailing moisture conditions and with fertilizer supplements. Your maximum stocking rate should be that animal number which can be supported during the *drier* periods of the year in situations where conservation of feed is not practiced. Where conservation is practiced, stocking rate can be increased to levels where excess forage produced in the rainy periods can make up the forage production troughs of the dry season. Stocking rate can be calculated in terms of animal units, one animal unit being a mature cow of between (375 to 450 kg).

The grazing cycle you practice is dependent on the forage species, growth habit and stage of growth. **Rotational grazing produces more beef per acre** as it allows for recovery and regrowth of the pasture. Where the quality and quantity of available forage does not meet the minimum nutritional demands of the herd, supplemental feeding will be necessary.

The three main production systems to be discussed are:

- Rangeland
- Semi-intensive
- Intensive (Feedlot)

Module 8 was specifically designed to amplify what is contained in this unit. That module was designed for those of you who need to add to what you may already know.

IF YOU WISH, YOU COULD BROWSE MODULE 8 AND SEE WHAT IS CONTAINED THEREIN, SO THAT YOU COULD COME BACK AND BETTER APPRECIATE THIS SECTION.

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3.1 Range Management Systems

Range management systems describe the situation where there are many breeding animals within the herd and the animals have large, fenced areas over which to graze. Rangeland usually consists of unimproved forage crops, some of which can be used for grazing. They vary widely in carrying capacity. These native grazing lands may or may not be devoid of trees and shrubs, and forage cover may comprise grasses, grass-like plants, legumes and broad leafed plants. They usually withstand grazing. Rainfall is the only source of moisture. Vegetation is dependent on soil type and fertility, drainage and climatic conditions.

Rangelands, like pasture, respond to good treatment. The main considerations are stocking rate and the application of soil ameliorants where economic. Natural reseeding is often an effective way to increase carrying capacity of your rangeland. Here grazing is deferred on a portion of the range until existing grasses have seeded or reproduced vegetatively. A careful study of forage species and their growth cycle is, therefore, required by you, the cattle operator, in order to determine these management practices.

Pasture size and carrying capacity depend primarily on total annual rainfall and its seasonal distribution. Therefore, stocking rates, may vary from as low as 1 to 2 cattle units per 1.0 hectare (2.5 acres), to a high of 1 cattle unit per 0.2 hectare (.5 acres).

Pasture sizes in range systems are usually larger than in semi-intensive systems, ranging from a low of 16 hectares (40 acres) to 80 hectares (200 acres). Fertiliser or other soil ameliorants are added usually to those pasture species which can improve productivity. Their use on range forage is likely to be uneconomic.

You have to give consideration to grazing systems, whether rotational or set stocking. Overgrazing must at all times be avoided. The grazing pattern should encourage the production of palatable nutritious forage species. The provision of water also acts as a controlling factor in determining your stocking rate. Mineral supplements strategically placed and protected from the rain are a necessity.

For you to obtain maximum productivity on range, some form of supplementation of the feed supply during the dry season is usually essential. Control of weeds on range land is important, as they reduce the already limited quantities of feed. Successful control requires knowledge of the species and their habits of growth.

3.2 Semi-Intensive Systems

This production system describes the situation where there are smaller areas of land utilised with smaller pastures than in range production. The number of animals may or may not be reduced. Lands used for this system may usually be regarded as “prime,” and returns on investment is a prime consideration when contemplating beef cattle as the enterprise. Pastures used for semi-intensive systems of livestock management usually consist of selected forage plants (*i.e.,* grasses, legumes).

Pasture species may be regarded as *permanent* (maintained indefinitely for grazing) or *temporary* (used in rotation with food crops or sown with annual forage plants to provide large amounts of forage for a short period from quick growing plants (*i.e.,* sorghum, corn,

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and napier). Improved efficiency of these forages in terms of dry matter production can easily compensate for a reduction in total land available for production. Animal performance on well maintained improved pastures exceeds that on unimproved pastures.

In order to maintain these levels of productivity several factors must be taken into consideration:

- Quantity and quality of forage available,
- The animal's seasonal requirements,
- Minimal supplemental feeding programmes.

The main goals of forage production in the semi-intensive system should be managing in order to maintain forage quality, as well as quantity; matching these with animal requirements in order to minimise the use of supplemental feeding. Forage species must be carefully selected to suit environmental and nutrient requirements. Fertilisation programmes must be properly worked out and managed. Weed control and managing the use of the pastures are of great importance.

The general rule is that the lower the quality of the pasture, the greater the forage needed to ensure selectivity of the higher quality parts (leaves over stems; young leaves over older leaves).

The key to semi-intensive management is matching animal nutrient demand with forage supply cycles. Deficiencies must be corrected through supplementation if animal performance is to be adequate.

3.2.1 Role of Conserved Fodder as a Supplement

Forage demand must first be identified in order to estimate supplementary feeding needs. During the breeding season, the addition of bulls and heifers to the breeding herds must be used in estimating the forage demand for the entire herd. Calves until weaning also make up the breeding herd. Range research in the U.S. has determined that on a year-long average, properly stocked livestock harvest about 25% of forage produced (referred to as a harvest efficiency of 25%). Your stocking rates are usually planned on the basis of animal levels of production. But inadequacy in seasonal rainfall requires supplemental feed.

Forage species utilized as supplemental feed sources must produce a high yield of product suitable for conservation. These forage species are usually short term, high-sugar crops and are usually conserved as silage. Excess growth of pasture grasses is best conserved as hay. **Conservation provides more efficient animal production by making use of otherwise wasted pasture surplus in the growing season.** This reduces the loss in body weight which may occur in the dry season and reduces possible mortality rates. Pasture hay is normally produced by reserving a field from grazing and cutting it at the optimal stage of development.

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3.3 Feed Lot Production

Cattle finished on concentrates, in general, produce beef which grade at higher standards than those cattle that are fed on grass only.

Feedlot management is the rearing of animals in confinement usually in specially constructed pens or buildings. The economics of this method of production depend mainly on, the type of cattle reared, level of management, availability and cost of concentrates or by-products, forage production systems and the price of meat. Pens or buildings are so designed as to save labour in feeding and handling, and, to protect feed from the weather. This system must reflect a carrying capacity greater than that of pasture grazing. Operations will vary from farm to farm but there are a few principles which relate largely to feeding, grading and efficient disposal.

At the start of operations, you need to conduct a survey of the area to be used for constructing the facility. The number of animals to be passed through will be affected by the space available.

In a system in which your cattle are restricted to a semi-paved yard an allowance of about 20 square feet per animal is required around feed and water troughs (for concentrate feeding along with herbage).

Where cattle are fed concentrates at a central trough and rotationally grazed in small paddocks, an area of about 20 square feet per animal should be paved, marled or stoned in the trough region.

- Lot space allocation per head for paved lots is 75 to 100 square feet and 150 to 200 square feet for marled or earth lots.
- Shade or shelter per animal ranges from 15 to 30 square feet.
- Feed bunk size (with feeding on one side) the width should be 24 to 30 inches; height 24 to 30 inches. Feeding on two sides should have a width of 30 to 36 inches; height 24 to 30 inches.
- You should have one mineral feeder, a 12’ x 12’ x 12’ box for every 50 animals. The height of the box from the floor should be 24 to 30 inches.
- You should perform the following basic management practices:
- Sort your cattle by size and sex, feeding in uniform lots of 10 to 100 per pen
- Dehorn your calves and clip the tips of horns of older cattle
- Control insects by spraying or dipping
- Deworm your cattle before putting them on full feed
- Keep lots clean, remove manure and other debris
- Inspect your cattle frequently for injury and disease
- Maintain a scale to check on rates of gain and sale weights

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- Plan your feeding programme in advance
- Make feed changes gradually
- Feed your animals at regular times each day.
- Watch their feed intake and where all feed is consumed, adjust your feeding rate.

Feeding troughs should be covered. Water should be provided at the rate of about 15 to 20 gallons per animal per day and there should be one drinking space per 20 head. There should be suitable storage for feed.

Most feedlot operations are based on a standard rate of concentrate feed for animals. Some are fed *ad libitum*. Standard feeding rates recommended range from 1.5 to 3.0% of body weight depending on the age of your animal. Weaners are usually started at the lower rate and feeding rate adjusted as the animals get older. Forage if offered is usually *ad lib*.

Effluent disposal and drainage is a major consideration in establishing a feedlot, as a muddy lot is a factor in foot rot and pink eye. If the area of the feed trough has inadequate facilities for natural drainage then you should make provision for drains and regular cleaning. Sloping of lots for drainage should be at the rate of 1/4 to 1/2 inch per foot for earth lots. On well drained soils, paving may be confined to areas around feed and watering areas. Fences around lots must provide both security and confinement.

3.3.1 Equipment needs

Feedlot production implies labour saving. You will require certain basic equipment to ensure this:

- Cattle scale, chute and squeeze for ease in handling
- Feed store
- Loading chute
- Water trough
- Feed trough

Your equipment should be planned for economy, using materials most available.

3.4 Management of the Breeding Herds

The primary objective of any beef cattle operation must be efficient beef production, measured in terms of numbers of calves weaned and liveweight gains from bulls, cows and steers. This means producing beef in such quantity, suited to market demand as cheaply as possible.

Regardless of the amount and quality of forage and other feeding materials available and the systems of management employed, the type of animal utilizing these resources will

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have a great effect on efficiency of production. Therefore, you should pay sufficient attention to choosing the foundation animals of the herd and subsequent replacements. The breed of animal chosen should first be adaptable, productive and popular for the specific environment. Your choice should be made on production records, body size and type, and sexual characteristics.

The choice of animal must also take into account prevailing market conditions. Selection of early maturing types (smaller size at maturity) will depend on market needs for a quality grade of meat. Late maturing animals develop less fat including marbling than early maturing animals.

In establishing your new herd, you may either purchase young producing cows or heifers. Young cows should have recently weaned a calf or should be still nursing one. The weaning weight and quality of the calf indicates the milking ability of the cow, as well as her ability to transmit type and performance. Older cows, if selected, should be from herds of high quality with complete records of age and production.

In purchasing cows, you must find out the reason for their sale. Heifers can be purchased as open or bred, and should be out of dams that have long records as calf producer.

The beef producer usually selects for a longer productive life span in beef cows. Once you have identified the animals which are productive and best fit your environment, basic management practices should then be put in place.

3.5 Herd Organisation

The groups of animals which may be found on the farm are:

- Breeding cows, dry or nursing with calves
- Replacement heifers -
    - Weaners to yearlings
    - Older heifers up to 27 months
- Herd bulls over 3 years
- Replacement bulls up to 3 years
- Weaned bull calves

For the cow-calf producer whose main aim is to sell calves at weaning while retaining only replacements, the following herds may be established:

- Breeding cows and ready-to-breed heifers
- Heifers up to breeding weight
- Herd bulls (individual paddocks are recommended.)
- Replacement bulls

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Purebred breeders would have all the above groups, while commercial operators might keep only groups 1, 2, and 3, as they usually buy most of their replacements, both male and female.

Stockers who are farm operators may purchase weaned and older cattle, allowing them to graze available forage until market weight. This operation is often a risky one. This because weight gains are realised only over long periods and are solely dependent on forage quantity and quality. Both purchase price and availability of adequate quantities of weaner calves or older animals may make this enterprise feasible only if run in conjunction with a cow-calf operation.

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4 Health Care

Quick Start h

The Learning Objectives of this unit are to familiarize you with the health care needs and target performance coefficients of beef cattle.

The Lesson /

A herd health programme involves the provision of measures to:

- Prevent
- Treat
- Eradicate

diseases and conditions which predispose animals to unthriftiness and low productivity.

One main provision your farm should employ is a quarantine area or an area which allows segregation and confinement and prevents contact with other animals on the farm. This is especially necessary for commercial producers who purchase animals on a continual basis.

Your daily observation is one key to detecting signs of developing disease. Provision of holding pens, chutes and relevant equipment, such as spray equipment and drench guns and nose holders, aid in the restraining and treatment of animals.

Proper nutrition is essential to good health, as poor nutrition predisposes animals to certain infections.

Treatment for ecto-parasites and endo-parasites are routine. Annual or bi-annual tests for other diseases such as Brucellosis and Tuberculosis must be facilitated.

You should check your cow herd at calving because navel sores, mastitis, and pneumonia are common at this time.

You may have to institute immunization programmes against Black Leg for weaned calves and older animals. There may also be programmes specific to the needs of your location. Please consult your local veterinarian for this information.

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4.1 Target Performance Coefficients

Table 4.1 Target Performance Coefficients for Beef cattle

Beef Cattle	
Age at First Calving	28 - 36 months
Age at First Breeding	20 - 27 months
Calving Interval	12 - 13 months
Body Weight at First Breeding	600 - 650 lb (65% - 75% mature weight)
Bull to Cow Ratio:	1:40 (Mature bulls)
	1:20 (Bulls 2 1/2 - 3 years)
	1:30 (Bulls 3 - 4 1/2 years)
Conception Rate (Pregnancy Rate)	90%
Calving Rate	85%
Weaning Rate (% Calf Crop)	50 - 90 days
Length of Calving Season	90 days
Mortality rate:	
Calves	5%
Yearlings	2%
Culling Rate:	
Replacement Heifers	20%
Cows	10% - 20%
Weaning Age	8 - 9 months

Suggested Reading

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Water Buffalo

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Water Buffalo Production

1. Water Buffalo Breeds and Breeding

Welcome to our discussion on Water Buffalo Production! This is a short unit, because water buffalo are in many respects very similar to cattle. This unit contains 5 sections which are quite short, and are as follows:

⇒ Breeds and Breeding of Buffalo

⇒ Water Buffalo Nutrition

⇒ Beef Production

⇒ Other Uses of Water Buffalo

⇒ Health

The goal of this module is to pique your interest about the feasibility of buffalo production. With the information that is presented, increased production makes cents! Dollars and sense.

Special instructions applicable to this module: In order to prevent duplication of information, various sections of this module, will refer you to prior modules in your manual. Please re-read these sections at that time to refresh your memory. Also, be sure to contact your Local Tutor so that you can visit some areas that have water buffalo. We realize there are not many areas in the Caribbean that have water buffalo concerns, but it will be worth your while to plan a trip to one of the areas for first hand observations.

As this module is quite short, we suggest that you could, if you wish to read further on Buffaloes, go on to read Anon (1981) and Cockrill (1977).

Learning Objectives

The learning objectives of this module are to provide you with knowledge of the history of water buffalo production in the Caribbean, the various breeds, quality of the beef and milk products, and the comprehensive endurance of the animal under our tropical conditions. After studying this module, we hope you will choose to tap the potential of this great creature. The learning objectives will now be listed for you.

- **Breeds and Breeding of Water Buffalo**
- **Nutrition of the Water Buffalo**
- **Beef Production from the Water Buffalo**
- **Other Uses of the Water Buffalo**
- **Water Buffalo Health**

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1.1 About the Water Buffalo

The water buffalo, *Bubalus bubalis*, is neither widely dispersed nor well known in the Caribbean. The major centres of water buffalo population are Trinidad (with an estimated 7,000 head), Guyana (with an estimated 2,000 head), Venezuela, Columbia, Brazil, Costa Rica, and Cuba. Though numbers are limited, the water buffalo has a role to play in Caribbean and Latin American livestock production. In fact, the unsatisfied demand for and exportation of buffalo stock from Trinidad and Tobago to Venezuela, Colombia, Costa Rica, Honduras, Brazil, Cuba and the southern United States of America over the last three decades suggests the perceived value of the species. Yet the populations of the two Caribbean community countries remain relatively small and buffalo, once found in the smaller territories of the Eastern Caribbean, *e.g.*, Grenada and Barbados, have all disappeared.

The Lesson *I*

1.2 Relationship to Other Domestic Cattle

The water buffalo is sometimes erroneously referred to in Trinidad and Tobago as a "Bison" just as the North American Bison is erroneously called a "Buffalo." All domesticated cattle come from the family *Bovidae* and subfamily *Bibovinae*. The latter is made up of the Genera Bos, (*Bos inducus, B. taurus), Bison* (North American), *Bubalus* (which includes the water buffalo) and *Syncerus* (the African buffalo). Water buffaloes are divided into River and Swamp types. Both are strong swimmers and wallow in water or mud-pools. Water buffaloes for this reason, and from the nature of their hide and skin, are referred to commonly as "hog" cattle in Trinidad. The wallowing is part of their "cooling mechanism," the reason for which will become clearer to you when the physiology of the animal is examined.

Interbreeding between water buffalo and *Bos taurus* or *B. indicus* cattle is not known to occur. The number of chromosomes of cattle is 60, while the swamp buffalo has 48 and the river buffalo 50. In distribution, the buffalo is not as widespread as cattle. In fact it is found mainly in areas where cattle have difficulty in thriving, mainly as a result of seasonal unavailability of feeds and sometimes heavy rainfall and flooding. Animal husbandry in such areas is generally poorly organised and undeveloped. With over 150 million head in the world, the buffalo is the large ruminant of the small farmer. Most animals are found in India and the Far East. However, they are important in terms of both numbers and production in Egypt, Iraq, Iran, Turkey, Italy and the neighbouring southern European countries.

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1.3. Special Physiological Traits of the Buffalo

The metabolic rate of buffalo is lower than that of cattle, with a body temperature of 38.2 to 39.1^{o} C, pulse rate 41 to 56 per minute and respiration rate 21 to 24 per minute. The animals adapt reasonably well to a wide range of ecological conditions, including high altitude. They are, however, sensitive to both cold and hot environments. The skin of the buffalo has a very thick epidermis. The horny layer is conspicuous and may be twice as thick as that of cattle. The sweat glands of the two species do not differ histologically, but while cattle have about 2,600 per cm^2 of skin, buffaloes have 400. The buffalo's sweat glands are larger but the glandular surface per cm^2 of skin is 1.07 compared to 3.08 for cattle. The skin as a percentage of live animal weight is also larger than that of cattle (***See*** Benn, 1983).

The young buffalo has a coat of soft hair like cattle but hairs become long, coarse, sparse and generally dark as the animal matures. The colour of the skin may vary from jet black through brown to pink but in general the skin is dark coloured. With a lighter coat of hair than cattle, buffalos absorb heat more readily . In fact, exposed to high solar radiation or if working in hot weather, with the poor sweating ability of the animal compared to cattle, heat stress results. Their love of wallowing is explained as a thermoregulatory mechanism.

While its thermoregulatory mechanism is described as being reasonably efficient, the reproductive system of the water buffalo is reported to be affected by climatic changes. The scrotum of the male is smaller than that of male cattle of similar size, and semen is not only less in volume than that obtained from the male *Bos*, but the motility and speed of the spermatozoa are also lower. Semen quality drops in the hottest months of the year. (There are also reports of lower quality semen in winter but this is of little concern under tropical conditions).

Breeding tends to be seasonal and is attributed by some to the high environmental temperatures/high humidity of summers but a photo-periodic effect is now given more credence. While there are definite peaks in calving, you can make breeding more uniform throughout the year through management and feeding practices.

Artificial insemination is most commonly used in breeding buffalo in India. Techniques used for cattle have had to be modified in small but significant ways to meet the species differences. The future use of A.I. in the Caribbean in water buffalo production requires continuing development.

1.4 Breeds and Breeding of Buffalo

Buffaloes tend to be large, big breed animals with heavy bodies, set low on strong legs with large hooves. The head is larger relative to cattle and is often topped by horns that are broad, flat, and almost rectangular in cross section with prominent ridges across the long axis. Some breeds have long backswept horns; others have shorter, tightly curled ones.

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4.1 Breeds

The great majority of buffalo are nondescript due to centuries of indiscriminate breeding. However, a few distinct breeds have been developed mainly for milk production and work. These are briefly described below.

Murrah

Murrah are predominantly black-skinned with a long tail and a white switch. The head is relatively small with a thin neck. Horns are short and tightly curled upwards. The body frame is compact and deep and females show good dairy conformation. Mature body weight is 550 kg for bulls and 450 of cows. It is the predominant breed in India and originated in the north.

Bhadwari

Bhadwari have brown or reddish-brown hair, pale legs and flat backward pointing horns that turn in and up at their pointed ends. They used for milk production and draught.

Surti

Surti are brown or black skinned with white collars on the neck, prominent eyes and short legs. The backline is straight with a broad square rump. The body is medium sized and shows good dairy conformation. The breed is a good milk producer and is early maturing. The head is broad and long and the horns grow downwards and backwards, curling upwards at the tip (sickle shaped).

Jaffarabadi

Jaffarabadi is the largest breed with a heavy head, bulging forehead with large horns that droop downwards and curl backwards. The skin is normally black. The body is relatively long and does not show as good dairy conformation as the other breeds. They produce high milk yields of high butterfat.

Nili-ravi

The head is long rounded and convex at the top but depressed between the eyes with wide nostrils. Horns are small, broad, thick and coiled. The neck is long and thin in the female, thick in the male. The body is medium sized with black or brown hair often with white workings. Dairy conformation is well developed.

Buffalypso

The Buffalypso was developed in Trinidad and Tobago, the land of “Calypso.” Hence the combination of Buffalo and Calypso to form Buffalypso.

Development of the Breed in Trinidad and Tobago

The first recorded imports of water buffalo into Trinidad was of 30 head of the Jaffarabadi breed in the early 1900’s. In 1919 they were introduced as draught animals on sugar plantations to replace the tuberculosis-prone Zebu. It was found decades later that while Buffalypso were relatively resistant to tuberculosis under

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the prevailing husbandry conditions, they were still susceptible. By the late 1950's and early 1960's the sugar industry was becoming more heavily mechanised and the water buffalo was less needed for draught purposes on the sugar plantations. The assembled animals constituted the original sugar company herd and became the foundation stock for the Buffalypso. The herd was established in 1963.

The various importations of water buffalo into Trinidad were of the Bhadwari, Murrah, Jaffarabadi, Surti and Nili-Rivi breeds from India. None of these breeds have remained pure and over the years there has been indiscriminate crossing. A veterinarian, Dr. Steve Bennett [who received the Honorary Doctorate in Science at the UWI, St Augustine, Graduation 2001], was attached to the sugar company, recognising the beef production potential, started to select animals for **liveweight gain and for conformation.**

The ideal Buffalypso animal is described by him as having:

- Reddish-brown or copper colour like the Bhadwari with a white star on the forehead being permissible;
- Skin thick and light;
- A broad head and face with prominent, intelligent-looking eyes, and horns that grow backwards and upwards, but not as tightly as those of the Murrah;
- The early maturity and the straight top line of the Surti;
- Well turned thighs and buttocks with twists well down the inside of the legs and the beef type conformation and strong legs of the Murrah.

The sugar company, Caroni (1975) Ltd., has expanded its herd to include just under 1,000 head at the present time. Larger farmers, particularly on coconut plantations on the east and south west coasts, have integrated water buffalo production on rough grazing land below their coconuts. Improvements in breeding by use of selected bulls from Caroni (1975) Ltd.'s or Dr. Bennett's herds have been attempted by many of these farmers.

The smaller farmer has continued to keep water buffalo, though wheeled tractors have become widely owned. Few buffalo are still milked and most are used for draught purposes with culled young or old stock entering the market for slaughter as beef.

Please note that the Buffalypso is not a Cross between the Cattle and the Buffalo!!!!!!

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1.2 Breeding: Reproduction in Buffalo

1.2.1 Male

Production of sperm is believed to start at above one year of age. As is the same for cattle, a water buffalo bull should not be used too early or overworked. Feeding the bull during the growing period, feeding for serving and general handling would be similar to the dairy bull, except that buffalo are not usually dehorned. It is important that a nose ring be installed so that the bull may be controlled if necessary. The bull may be used until ten years of age. Since breeding tends to be seasonal, a bull to female ratio that is reasonably conservative should be maintained, *i.e.*, about 1:50 or less.

1.2.2 Female

Cows reach maximum liveweight by about seven years of age when the fourth calf is born. There is wide variation in the age of puberty but this varies with breed and, more importantly, husbandry practices. Age at first calving depends on management and varies between 2 and 4 years locally.

- ***Oestrus***

In the Far East oestrus is typically not seen until about two years age. There are conflicting reports on the length of the oestrus cycle. Heat is believed to be demonstrated more at night, with breeding taking place typically at night or in the early morning. The length of the oestrus cycle is 21 days but it can vary upwards to 28 days. Heat detection with silent heats**?** may be a problem. The oestrus period may last from 1.5 to 4 days.

- ***Ovulation***

Ovulation occurs after oestrus has ceased and appears to be similar to ovulation in cattle. The gestation period exceeds 300 days, averaging about 305, but there are reports of average gestation lengths being seven to ten days longer.

- ***Calving***

Calving is seasonal. Some workers ascribe this to climatological changes. Better performances have been noted in the cooler months. Suggestions are that this is a photoperiodic influence. In Trinidad, over 80% of all calvings occurred between July and December in a free mating herd and over 90% of cows in the herd calved.

The calving interval varies with management from 400 to 600 days. Better management lowers the interval and in well managed herds it can be as low as 430 days.

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2 Water Buffalo Nutrition

Water buffalo husbandry is relatively undeveloped, but work on this species is widespread in India and Asia, in the Caribbean and Latin America. Traditionally buffaloes are found in countries where land, cultivated and forage crops and pastures are limited. Water buffalo are usually owned by small farmers of limited means; maintenance costs and inputs are low and the products are largely used for subsistence. Maturing under the conditions of short supply of nutritionally unbalanced feeds, the buffalo has developed, justifiably a reputation of possessing great ability to thrive under adverse conditions.

Learning Objective

The learning objective of this unit is for you to have a appreciation of the feeding and nutrition of the water buffalo.

The Lesson

The visual comparison is often made between buffalo and *B. indicus* or *B. taurus,* under identical poor management circumstances, and the buffalo invariably is the best fleshed animal.

There are gaps in the understanding of the nutritional physiology of the buffalo. The animal is, however, believed to :

- more efficiently digest cellulose material
- more efficiently digest protein, non protein nitrogen, fat and minerals.

Digestibility differences between cattle and water buffalo on poor quality forage have ranged from 6 to 16 per cent in the buffalo's favour. The above abilities are thought to be related to the micro-organisms in the rumen, which are reputedly more efficient than those of cattle in producing volatile fatty acids. Other factors in digestive capability compared to cattle include:

- Higher DM intake. (This has been consistently found to be the opposite by work done in Trinidad and Tobago under feedlot conditions, as described below).
- Longer retention of feed in the digestive tract.
- Better utilisation of ammonia-nitrogen.
- Less depression of cellulose digestion by soluble carbohydrate.
- A wider preference for coarse fodders.

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Work in the 1960's showed grazing buffalo gaining 0.72 kg compared to 0.65 kg per day by Brahman and Jamaica Red cattle on poor quality pasture supplemented with bagasse[1] and molasses. Other reports generally have the buffalo outperforming cattle in terms of liveweight gain, by sometimes as much as twice the cattle level under similar conditions. Since little is certain about the nutrition of the buffalo, feeding as prescribed for growing beef cattle by the National Research Council of the United States is recommended.

Between 1979 and 1988 various feeding trial comparisons were done among growing water buffalo (Buffalypso), Holstein steers, Holstein bulls and beef type animal under feedlot conditions. Feeding to zero grazed animals as the roughage source, either sugarcane silage, fresh sugarcane or untreated bagasse, the results obtained for buffalo bulls and Holstein steers are shown below:

Table 2. Comparison Under Feedlot Conditions of Water Buffalo with Holstein Steers

	ADG (kg)	FCE
Buffalo	0.70	9.2
Holstein	0.39	23.3

Activity L

Please refer to:

Garcia, Neckles, Lallo and Bennett (1991).

What's ADG and FCE?

The feed intake of the buffalo was consistently lower than that of the Holstein steers whether on a kg per day or percent liveweight basis.

In more recent feeding trials utilising uncastrated Holstein bulls and beef breed bulls on low roughage (25% of the diet DM chicken litter based), high performed diets, the results were as follows:

[1] The dry refuse of sugarcane after the juice has been expressed.

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Table 2. Feeding Trials Comparison of Water Buffalo with Holstein Bulls and Beef Breed Bulls

	ADG (kg)	Kg DM Intake/100 kg 1ive wt.	FCE
Buffalo	0.97	2.2	5.4
Beef Breeds	1.19	2.0	4.7
Holstein	0.94	1.8	4.8

These results suggest that under feedlot conditions with high quality rations, the buffalo may be at a disadvantage compared to beef breeds or Holstein. However, as seen, it is an animal in the Caribbean eminently suited to feedlot rearing, especially coming out of a cow-calf operation, the typical circumstance under which animals are produced.

Activity P

Prepare a chart comparing digestion in the rumen of water buffalo to digestion in cattle.

Activity E

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3 Beef Production

Handling Characteristics

The water buffalo, when well managed is suitable for beef production. Once well treated and accustomed to the presence of humans, they are quite tame. Young animals 6 - 12 months of age coming off range in a fairly wild state are tamed by three weeks of handling in feedlot. However, keep in mind that these animals are creatures of habit and, when accustomed to a routine, are easy to handle. Differences in routine can be met with some resistance. Even on pasture, animals have a curious habit or approaching persons, often at high speed, to within 25 or 30 meters, and maintaining that distance by retreat or advance, depending on the movements of the “intruders.”

Buffaloes are social animals inclined to move in groups. Where the leaders go, the others follow. They can forage someone's nearby garden at night and be back in their allotted pasture by daybreak. So you can see why it is important then to keep your animals well fed. They move in response to their feed needs and are notorious for pushing their way through, or pushing down barbed wire fences when hungry. They may raise fences from the bottom wire with their horns, so any fencing wires you use need to be stronger, closer spaced and heavier than for other cattle. Electric fencing is very effective.

Management and grazing systems are as for beef cattle with the provision for fences. Feed troughs, etc. may be the same dimensions as for cattle but chutes and crushes may need to be widened.

Feeder Bulls

The object of the beef breeding herd is to produce animals either for direct sale as beef or for finishing prior to sale. The average birthweight of the calf is 30 to 36 kg. Sometimes a mother will ignore her calf, but cows may adopt calves, allowing several calves to suckle freely. Artificial rearing of calves is done in some other parts of the world but has not been done in the Caribbean. Buffalo calves are not very amenable to hand feeding.

On pasture, animals are weaned between 6 and 8 months of age, at a liveweight of approximately 200 kg. These animals are suitable for feedlot rearing and could grow at a rate of almost 1 kg per day depending on feeding. On pasture, weight gains are 0.40 to 0.65 kg per day.

Carcass and Meat Quality

The buffalo converts feed into lean meat more efficiently than cattle, one study showing lean to be 11% higher, fat 7% lower and bone percentage to be very similar, compared to cattle. The dressing out of the carcass is up to 3 per cent lower than that of cattle. This is because of the high proportional weight of the skin and head relative to cattle, 8.3 and 6.0 per cent respectively in buffalo and there is also less pelvic fat. In fact, even though it has a layer of subcutaneous fat, this is usually thinner than for comparably fed cattle. Fat levels in buffalo meat are generally well below 25 per cent, unlike the situation with well-fed cattle.

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Animals can reach a slaughter weight of 350 kg in well under two years. Buffalo meat and beef are basically the same. Muscle pH (5.4), shrinkage on chilling (2%), moisture (76.6%), protein (19%) and ash (1%) are similar to cattle. The meat is darker, the fibres thicker and nuclei more numerous than in beef. The fibres are polygonal in cross-section. Buffalo fat is white with no carotene and there is little or no marbling or intramuscular fat. There is evidence that the connective tissue of buffalo hardens less rapidly than that of cattle with advancing age.

In Trinidad, young buffalo meat has been sold over the years as beef to customers. However, because buffaloes were usually slaughtered after their working lives (as draught animals), their meat was very fibrous and buffalo meat came to be associated with toughness. This situation changed slowly, then more rapidly over recent years with the controlled rearing of buffaloes. A taste panel as early as the 1960's rated buffalo meat superior to that of beef cattle breeds, local or imported. The promotion of young feedlot finished bulls over the last few years by the Sugarcane Fields Centre and other producers, has led to a change in attitude to the meat.

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4 Other Water Buffalo Uses

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Guess what? More than 60% of the milk produced on the Indian subcontinent comes from the buffalo. Buffalo milk sells at a premium price compared to cattle milk. In India, while some breeds show higher levels of milk production, in general, average lactation yields under good management vary from 1,450 to 2,200 kg. Average yield of milk per buffalo per year in the population is approximately 500 kg. In Egypt average milk yields of buffalo are generally higher compared to local cattle — 680 to 800 kg *vs.* 360 to 500 kg. Yields vary widely and the buffalo is particularly adapted to integrated small farmer systems where roughages are converted into feed dailygiving a limited supply of nutritious milk. On well managed farms with improved breeding, milk yields of over 3,500 kg per 285 day lactation were recorded in Pakistan.

The Lesson

4.1 Milk Production

In Honduras, water buffalo originating from Trinidad and Tobago yielded 830 kg over 220 days, under a system of suckling calves for 4 hours daily after complete milking. These animals were pasture fed in the rainy season and on sugarcane and supplement in the dry season (please turn to Williams, 1988).

At the Sugarcane Feeds Centre in Trinidad, an attempt was made to milk first calving heifers (brought into feedlots as yearlings from the beef herd) after range rearing was found to be too dangerous. It is felt that rearing animals with closer human contact from an earlier age would lead to better success.

Buffalo milk contains less water, more solids, more fat, slightly more lactose and more protein, casein, albumin and globulin than cow's milk. Total solids is over 16% and fat level is over 50% higher than that of cows' milk (6-9%). Phosphorous level is also higher and salt is lower. Buffalo milk is white due to the absence of carotene (though not of Vitamin A). It is higher in energy than cows' milk. Phospho-lipids are lower but cholesterol and fatty acids are higher. Digestibility is not adversely affected and the fat yield per lactation compares favourably with that of high producing temperate cattle.

The characteristics of the dairy buffalo closely approximates those of the dairy cow, so that the initial problems you encounter in breeding, husbandry, and udders and milk let down can be overcome. The virtue of the buffalo as a milk producer is that it does not need the quality of feed of dairy cattle and its high-solids milk is useful for making cheese and butter, taking two-thirds of the quantity of cattle milk to give a similar yield of product.

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4.2 Buffaloes for Draught

In the Caribbean draught animals have, since the mid seventies oil crisis, made a minor "comeback" in importance. Previously the tractor and other mechanical means were rapidly displacing such animals. The water buffalo is particularly suited for draught purposes. While it works slowly and needs to be cooled down every two hours or so, its large feet and body weight distribution make it ideal for haulage in wet conditions. Many Caribbean farms would be well served by buffalo with carts, particularly smaller dairy farms of 2 to 5 hectares involved in zero grazing.

Harnesses have been shown to sometimes reduce the ability of the animal to work through restricting neck movement. Innovations like the leather horse strap or breast strap have improved pulling power and speed. While normal leather may rot in high humidity, buffalo skins can be used to produce a tough leather which may last longer.

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5 Health

While water buffaloes have a deserved reputation for being healthy, commonly occurring viral, bacterial and parasitic diseases are much the same as for cattle. Susceptibility differs but most treatments for cattle are similar to those for buffalo. Most mortality losses occur in the young calf category, and viruses, bacteria and poor nutrition all play a part. Wallowing also exposes the calf to water borne diseases. Diphtheria, pneumonia, coccidiosis and diarrhoea are notable buffalo calf ailments. The following are the main diseases affecting the water buffalo in the Caribbean.

- ***Tuberculosis***

While not as susceptible as cattle, buffalo are not immune to this disease. Tuberculosis can affect the buffalo but this is an indication of housing and management inadequacies. In India and Egypt it has been found that the rate of tuberculin reactions is higher for buffalo than for cattle.

- ***Foot and Mouth Disease***

Buffaloes are also more resistant than cattle to foot and mouth disease, but severe outbreaks have been known to occur in the Far East. Lesions on buffalo are said to be smaller.

- ***Mastitis***

Milking buffaloes can be seriously affected by mastitis caused by pathogenic *Staphylococcus* and *Streptococcus*. In some herds up to 20 per cent of animals showed sub-clinical infections. Treatment is as for cattle.

- ***Piroplasmosis***

This is said to affect buffaloes as much as cattle. Since buffaloes are resistant to ticks, healthy animals are not normally affected by this tick borne disease. Wallowing and rubbing may play a part in reducing tick infestation. However, animals kept on concrete may harbour ticks.

- ***Screwworm***

Buffaloes are not affected by this major pest of cattle. Even untreated navels of the young hardly ever become infected.

- ***Lice***

Buffaloes are affected by a lice, especially if in a weakened condition and when wallowing is not possible. Mange can be a serious disease, especially among calves.

- ***Liver Fluke***

Fasciola sps. infect buffaloes and damage the liver. Though infection may be high, there are no clinical symptoms. It is believed liver damage reduces growth, work output and general productivity.

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- ***Coccidiosis***

This can cause heavy mortality in calves.

- ***Roundworms***

Roundworm infection is transmitted from dam to offspring before or soon after birth. Mature animals are not susceptible but infestation in calves can be serious enough to occlude the small intestine. Roundworms are readily controlled by antihelmintic preparations.

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