Hair Sheep Manual

By Gerry Thomas, Animal Scientist
# Table of Contents

1.0 **INTRODUCTION**
   1.1 Origin
   1.2 Characteristics Hair Sheep
   1.3 Some important facts about sheep
   1.4 Production coefficients

2.0 **BREEDS OF HAIR SHEEP**
   2.1 Introduction
   2.2 Historical Background of Barbados Blackbelly Sheep
   2.3 Breeds
      2.3.1 Barbados Blackbelly
      2.3.2 Persian Blackhead
      2.3.3 Virgin Island White
      2.3.4 West African

3.0 **PRODUCTION SYSTEMS**
   3.1 Extensive system
   3.2 Semi-intensive system
   3.3 Intensive system
   3.4 Economics of lamb production

4.0 **GENERAL MANAGEMENT AND HUSBANDRY PRACTICES**
   4.1 Selection
   4.2 Reproduction
   4.3 Care of the ewe
   4.4 Signs of lambing
   4.5 Dystocia
   4.6 Milk Production
   4.7 Milk Composition
   4.8 Lamb Rearing
   4.9 Artificial Rearing of lambs
   4.10 Fostering
   4.11 Artificial Milk Feeding
   4.12 Artificial Colostrum
   4.13 Weaning
   4.14 Lamb Mortality
   4.15 Estimation of Age
   4.16 Estimation of Weight
   4.17 Housing

5.0 **FEEDING MANAGEMENT**
   5.1 Conventional feeding
   5.2 By-product feeding
   5.3 Water
<table>
<thead>
<tr>
<th>Section</th>
<th>Subsection</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.0</td>
<td>HEALTH MANAGEMENT</td>
<td></td>
</tr>
<tr>
<td>6.1</td>
<td>Introduction</td>
<td></td>
</tr>
<tr>
<td>6.2</td>
<td>Pest and Diseases</td>
<td></td>
</tr>
<tr>
<td>6.2.1</td>
<td>Internal Parasites</td>
<td></td>
</tr>
<tr>
<td>6.2.1.1</td>
<td>Signs of parasitism</td>
<td></td>
</tr>
<tr>
<td>6.2.1.2</td>
<td>Treatment</td>
<td></td>
</tr>
<tr>
<td>6.2.1.3</td>
<td>Management practices</td>
<td></td>
</tr>
<tr>
<td>6.2.1.4</td>
<td>Seasonal variation in worm load</td>
<td></td>
</tr>
<tr>
<td>6.2.1.5</td>
<td>Gastrointestinal nematodes (GIN)</td>
<td></td>
</tr>
<tr>
<td>6.2.1.6</td>
<td>Tapeworms (Cestodes)</td>
<td></td>
</tr>
<tr>
<td>6.2.1.7</td>
<td>Coccidiosis</td>
<td></td>
</tr>
<tr>
<td>6.2.2</td>
<td>External Parasites</td>
<td></td>
</tr>
<tr>
<td>6.2.2.1</td>
<td>Sheep Nasal “Bot” Fly</td>
<td></td>
</tr>
<tr>
<td>6.2.2.2</td>
<td>Nutritional or metabolic diseases</td>
<td></td>
</tr>
<tr>
<td>6.2.2.3</td>
<td>Pregnancy toxaemia</td>
<td></td>
</tr>
<tr>
<td>6.2.2.4</td>
<td>Bloat</td>
<td></td>
</tr>
<tr>
<td>7.0</td>
<td>REFERENCES</td>
<td></td>
</tr>
</tbody>
</table>
1.0 INTRODUCTION

1.1 Origin
Sheep and goats were known to be the first ruminants to be domesticated by man, sometime between 10,000 and 6,600 years B.C. (Zeuner, 1963). Domestication took place in south-western Asia, probably in what we know as Iraq and Iran. Sheep share with other ruminants the ability to convert fibrous, often low quality feedstuffs, into valuable, life-sustaining products for human use, such as meat, milk, wool and skins.

Domestic sheep (*Ovis aries*) indigenous to Africa probably came from Asia or Europe as there are no indigenous domesticated hair sheep in the Americas. They belong to family of Bovidae — hollow horned ruminants — which include cattle and goats. The first domesticated sheep imported to South America probably came from Europe during the sixteenth century. The only species of wild sheep in the Americas is the American Bighorn (*Ovis canadensis*) but this was never domesticated.

Hair sheep account for approximately 7 to 10% (about 100 million head) of the world’s 1.1 billion population, of which 2 million are found in the Caribbean region. Hair sheep have evolved by natural selection and by controlled breeding programmes and selection by man. They have hair coats similar to cattle and goats and in Cuba and Mexico are called Pelibuey and in Brazil, ‘Pelo de Boi’, meaning hair of the ox. Temperate breeds of sheep (wool) are more numerous and are economically more important than hair sheep but the hair sheep are well adapted to tropical environments, an important advantage in many developing countries.

1.2 Characteristics Hair Sheep
- Mature weight of 30 to 40 kg for ewes and 45 to 60 kg for rams
- Compact conformation
- Thin tail extending to hock or shorter
- Small ears carried horizontally
- Rams and ewes usually polled
- Pronounced mane and throat ruff on many rams
- White and shades of brown from tan to red to dark brown are the most frequent coat colours.
- Heat cycle (oestrus) is on average every 17 days
- Average gestation period is 150 days.
1.3 Some important facts about sheep

*Normal Hair Sheep Physiological data:*

- Temperature: 103.1°F (39.5°C)
- Heart rate: 120 beats per minute
- Respiration rate: 30 per minute (at rest)
- Onset of heat: 8-12 months, depending on nutritional regime
- Length of heat: 18 to 30 hours, (average 24 hours)
- Heat cycle: 15 to 19 days, (average 17 days)
- Length of pregnancy: 145 to 155, (average 150 days)
- Time of ovulation: 25 - 30 hours after the onset of heat
- Conception rate on a flock basis: 85%
- Average no. of lambs/lambing: 1.5 - 2.0 (depending on breed)
- Milk production: 250 - 630 g per day

*The body temperature is related to stress, exercise and the environmental temperature.*

1.4 Production coefficients

- Ram to ewe ratio: 1 to 30
- Lambing rate: 85%
- Ewe replacement rate: 20%
- Ram replacement rate: 20%
- Age at first breeding: 8 months
- Mortality: 10 - 15%

2.0 BREEDS OF HAIR SHEEP

2.1 Introduction

There are several breeds of hair sheep in the tropics and each breed has evolved and/or have been developed to suit its particular ecological niche. Some of the more popular hair sheep breeds found in the Caribbean are: Barbados Blackbelly, Persian Blackhead, Virgin Island White, West African and Corentyne White.

The breed most commonly found in the English speaking Caribbean is the Barbados Blackbelly. Hair sheep populations are found on many Caribbean islands, in Central and South American countries around the Caribbean basin, and in eastern Brazil. In 1904, the US department of Agriculture imported 'Barbados sheep' into the United States from Barbados while in the 1960's and early 1970's exports from Barbados went to Canada, Mexico, Taiwan, Grenada, Guyana, Jamaica and other Caribbean countries.
2.2 Historical Background of Barbados Blackbelly Sheep

The first historical reference to hair sheep in Barbados appears in Ligon's History of Barbados, 1657 (Patterson, 1976). Devendra (1977), Patterson (1976), Maule (1977) and Mason (1980) have all speculated on the origin of the Barbados Blackbelly sheep breed. Barbados Blackbelly sheep may be of African ancestry but there is compelling historical evidence which suggests that, as a breed, it originated and evolved in Barbados from crosses of African hair sheep and European wooled breeds of unknown origin (Combs, 1983). Devendra and McLeroy (1982) also suggested that the Barbados Blackbelly sheep is of West African origin, introduced into the region via Brazil, by the Spaniards and Portuguese in the seventeenth century. They are closely related to the Cuban hairy and Brazilian woolless breeds.

Barbados Blackbelly sheep by its own nature, is thought to have the ability to withstand infestation with internal parasites. Serious outbreaks of 'worms' occur only if environmental conditions are unfavourable and one wonders if the use of dewormers do help in breaking down natural ability of the sheep to withstand these 'worms'.

In the 1950s the Wiltshire Horn was introduced into Barbados for crossbreeding with the Barbados Blackbelly breed while in the 1970s, Suffolk and Dorset breeds were also introduced in an effort to improve the Barbados Blackbelly. The results of these crossings were disappointing, as these animals were unable to withstand the environmental conditions of the tropics. Crossing with other hair-type breeds of known pedigree would probably have been more beneficial.

2.3 Breeds

2.3.1 Barbados Blackbelly

- Prolific (1.50 - 2.30 lambs/lambing), good meat type
- average weight: ewes-40-60 kg and rams 60-90 kg
- height at withers of adults is 60 -65 cm
- both rams and ewes are polled; ewes have a well developed mammary system
- breeds at any time of year and twice per year lambing is common, along with a high percentage of multiple births
- annual lambing rate is above 150%
- found throughout the Caribbean and as far north as Oregon and Michigan in the USA.
2.3.2 Persian Blackhead
- Commonly known as 'Blackhead Persian'
- head, neck and feet are black, while the rest of the body is white
- low twinning rate (1.08 lambs/lambing)
- meat breed but poorer mutton type
- average weight: ewes -35-40 kg; average height at withers of adults is 55-60 cm
- fat rumped, long legged and polled in both sexes
- breeds at any time of year but lacks prolificacy, unlike the Barbados Blackbelly
- found in Tobago, Antigua, the British Virgin Islands, Guyana and Venezuela

2.3.3 Virgin Island White
- Relatively new breed
- predominantly white in colour
- more prolific (1.45 to 1.90 lambs/lambing) than other hair sheep breeds except the Barbados Blackbelly
- polled
- average weight: ewes 32-43 kg and rams 50-60 kg

2.3.4 West African
- Originated from West Africa
- reddish brown or rust in colour with the under parts, inner sides of the legs, ears and face of a lighter colour
- long-legged and dwarf types
- low twinning rate (1.15 - 1.50 lambs/lambing)
- average weight: ewes 25 kg; and rams 37 kg
- average height at withers for long legged and dwarf is 55-65 cm and 45-50 cm respectively

3.0 PRODUCTION SYSTEMS
The majority of sheep in the Caribbean and in particular Barbados, are kept by small farmers who are considered to be landless or land limited. Sheep are kept under three production systems, (a) extensive, (b) semi-extensive and (c) intensive.

3.1 Extensive system
This production system is perhaps the most traditional method of rearing sheep and goats and includes those systems where sheep are grazed during the whole or most of
the year on natural pasture and rely principally on feed produced from the pasture. In this system, facilities both for housing and handling are simple, minimal and usually inexpensive (Osuji, Archibald and Lallo, 1982).

Extensive small ruminant production systems are unorganised, leading to low efficiency of production with limited opportunity for improved management. Overhead costs are low utilizing scrub lands that are otherwise unutilizable. Animals in this system also suffer from high levels of mortality, particularly among the young.

3.2 Semi-intensive system
Under this system, animals are allowed to graze or are fed forages from improved pastures under a cut-and-carry system or fed on crop residues. The feeding of supplements and some kind of formal management, either of pasture and/or of animals are practised. Animals managed under the semi-intensive systems receive better feed and care which results in increased overall productive efficiency relative to the extensive system. Under this system, higher growth rates can be achieved on grazed pastures with adequate supplementary feeding.

3.3 Intensive system
In intensive production systems, ruminants are managed in confinement with very little or no grazing or browsing. Prior to 1975, this system of production was not very popular in the Caribbean, but interest is increasing. Intensive production systems lend themselves to increased levels of productive efficiency and afford increased opportunities to improve management through better utilization of by-products. This system has the potential for substantial increase in output and efficiency by intensifying production and by careful integration of available resources and management practices. Maintaining sheep in a controlled environment reduces the physical activity required to pursue food and directly reduces energy requirement for maintenance by up to 40%. This saving is of major economic significance, because feeding ewes represents the largest cost in lamb production.

However, this system is also associated with high initial investment cost in labour, housing, feeds and feeding as well as handling facilities. In addition, there is a higher incidence of diseases such as coccidiosis which is accentuated by confinement.

3.4 Economics of lamb production
The relatively short production cycle of the sheep, coupled with the variety of feed resources that can be used for sheep production, allows considerable latitude in the
design of sheep production systems. The ability to produce many lambs (prolificacy) is the most important factor affecting the profitability of sheep production enterprises.

Some breeds, e.g. the Barbados Blackbelly, are highly prolific giving two to four lambs per birth, but lamb survival when more than two lambs are reared by the ewe has often been low. The sheep producer will make more profit by increasing the number of lambs reared per ewe than from any other single factor e.g. carcass quality or even growth rate. The important objective of the sheep farmer therefore is to save and raise all the lambs born. This can be accomplished by:

- ensuring that the ewe is properly and adequately fed during pregnancy and lactation.
- making an early decision on alternative lamb rearing methods when two or more lambs are produced.
- ensuring that all lambs get colostrum within 30 minutes of being born.
- feeding the lambs enough of a balanced diet, be it pasture and/or a sheep concentrate.
- implementing a proper health care programme.

The economics of rearing sheep under an intensive production system was compared with those of semi-intensive and extensive systems. The average daily gain and cost per ewe per year was higher under the intensive system when compared with the semi-intensive or extensive systems of production (Table 1). However, the extensive system also showed a loss (Table 1). This makes lamb production under the intensive system uneconomical and hence the farmer should consider using the semi-intensive system and supplementing the ewes at strategic times only with least cost rations formulated from agro-by-products.

Rearing lambs on two agro-by-product lamb starter rations, tested and validated by CARDI, for pre- and post-wean feeding, gave ADG of 153 and 143 g respectively. The composition of these rations are shown in Table 4. These rations could replace the commercial starters at a lower cost per unit gain without compromising the rate of gain.
**Table 1** Economics of rearing sheep intensively, semi-intensively and extensively

<table>
<thead>
<tr>
<th>Input/Output</th>
<th>Intensive</th>
<th>Semi-intensive</th>
<th>Extensive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed intake/ewe/yr (kg)</td>
<td>597</td>
<td>207</td>
<td>283</td>
</tr>
<tr>
<td>Feed cost/ewe/year (Bds $)</td>
<td>157.16</td>
<td>60.13</td>
<td>94.93</td>
</tr>
<tr>
<td>FMP (kg lamb/year)</td>
<td>20.75</td>
<td>20.44</td>
<td>15.09</td>
</tr>
<tr>
<td>Value/ewe/year (Bds$)</td>
<td>124.51</td>
<td>122.65</td>
<td>90.56</td>
</tr>
<tr>
<td>Annual profit (Loss)(Bds$)</td>
<td>(32.65)</td>
<td>62.52</td>
<td>(4.37)</td>
</tr>
<tr>
<td>Flock Efficiency</td>
<td>1.36</td>
<td>1.33</td>
<td>0.99</td>
</tr>
</tbody>
</table>

Source: Thomas 1994

FMP - Flock Meat Productivity = Litters/year x litter size x survival rate x weaning weight  
Flock Efficiency = FMP / weight of ewe

4.0 GENERAL MANAGEMENT AND HUSBANDRY PRACTICES

4.1 Selection

There are two ways to improve the genotype of a breed, selection and breeding. Selection is the process of choosing certain individuals in preference to others as parents of the next generation. The main objective of selection is to improve overall productivity e.g. meat or milk output and at the same time improve the efficiency of production. The main methods of selection are performance testing, pedigree evaluation and progeny testing. Comparing individuals on the basis of their own performance is called performance testing and this is the simplest method to choose animals for parents of the next generation.

Pedigree evaluation is based on information on the ancestors of an individual and is used to provide useful information about the potential genetic worth of the individual in question.

Progeny testing is the performance testing of an individual’s offspring, as individuals pass half of their genes onto their offspring. This information is extremely important where information on their sire and dam is unavailable.

4.2 Reproduction

The Barbados Blackbelly are, like other tropical hair sheep, low-producing and yield below their genetic potential because of sub-standard feeding and management practices. Most small farmers are reluctant to change traditional practices because they are tied to a minimum input production system. However, some breed improvement has
been carried out and indications are that the process of improvement can be speeded up through the application of modern breeding systems and techniques.

Barbados Blackbelly sheep have an aseasonal reproductive cycle, that is, they can be fertilized at any time of year and not only in certain seasons, as is the case with temperate breeds. Litter size in the Barbados Blackbelly increases from 1.7 in the dry season to 2.2 in the rainy season possibly due to influence of better nutrition. Temperate breeds of sheep are seasonal breeders and the heat period normally occurs during late summer and early autumn (the shorter days) while lambing occurs in late winter and early spring.

The first oestrus (heat), the start of puberty, occurs between 6 and 8 months and non-pregnant ewes come into heat on average every 17 days. The signs of heat in the ewe are not obvious unless a ram is present; the heat period lasts about 1 to 2 days. However, experienced farmers will recognize nervousness, frequent urination and tail twitching as signs of heat. The eggs are shed about 24 hours after the start of oestrus and if they are not fertilized during this period, oestrus will reoccur about 17 days later.

The male attains puberty at about 6 months of age, depending on the level of feeding management, but should not be used as a stud until one year old as young rams produce semen with low sperm count making them incapable of mating successfully.

They are several systems of mating but the ones most used are random and controlled mating. In random mating, one or more rams are left permanently with the ewes and mating and lambing continue throughout the year. However, in this system, it is difficult to organize selective breeding and this often leads to inbreeding. In many instances, young ewes are bred too early. In controlled mating, several ewes are exposed to one ram for a predetermined period. This overcomes the constraints of the random method as the lamb’s sire is known with absolute certainty. Controlled mating allows breeding to be rationalized by bringing together the best males and females, and for this reason it is the method used in genetic improvement programmes.

4.3 Care of the ewe
To achieve maximum lamb survival the farmer must start early by caring for the ewe before she gives birth. The ewe should be dewormed before breeding, mid-way in gestation and just before lambing to reduce the risk of producing weak lamb(s) and to prevent the lambs from worm infestation at birth. All pregnant ewes should be observed prior to and during lambing, where possible, to ensure that they lamb without problems. When milk yield, and hence lamb growth rates are high, ewe weight loss after lambing may be as high as 20%.
4.4 Signs of lambing
Towards the end of pregnancy
the udder swells and become visibly larger, the ewe becomes restless, paws the ground,
and finds a suitable place away from the flock for lambing. At this stage the 'water bag'
appears at the vulva and bursts, releasing a viscous liquid. In a normal presentation, the
lamb emerges with its nose resting on the two forelimbs (Figure 1), which are stretched
out in front. Lambing takes about 10-20 minutes. With more than one lamb being born,
the second is usually born approximately 15 minutes after the first. After lambing, the
ewe licks the lamb(s) to remove membranes covering the lamb(s) and this stimulates the
lamb to move. If the afterbirth or placenta is not expelled within 24 hours after lambing,
veterinary assistance should be sought. The lamb(s) should start suckling within 15
minutes after birth. In communal lambing systems, light should be provided as sheep
seem not to see well at night and lambing in darkness tends to increases lamb mortality.

4.5 Dystocia
Sometimes the ewe experiences difficulty in lambing. This is known as dystocia and
occurs either when the lamb(s) is in a correct position but is too large to be expelled
easily or when the lamb(s) is in an incorrect position in uterus (Figure 2).
After lambing the following steps should be taken, where necessary:
• make sure that the lambs get colostrum
• treat the navel with a disinfectant
• record the weight of lamb, the name and/or number of dam and sire, this is useful
  when selecting replacement stock to avoid inbreeding.

Figure 1 Normal lambing presentations
4.6 Milk Production

Hair sheep, like other non-dairy breeds, are difficult to milk because milk let-down is only in response to the lamb suckling. Milk secretion is a continuous process with the milk being stored in the udder until it is removed by suckling or milking. If the milk is not removed, secretion stops; this happens when the lambs are weaned or if the lamb dies. Milk let-down occurs in response to the hormone, oxytocin, which is produced in the pituitary gland near the brain.

Total milk yield is affected by nutrition, the number of lambs suckled, the age and number of lactations of the ewes. The potential growth rate of the lambs during the first month is likely to be limited by milk yield for ewes suckling more than one lamb. Undernutrition of ewes in the last four to six weeks of pregnancy not only reduces milk yield, but also lamb birth weight. Supplemental feeding during this period is critical to promote rapid growth of the unborn lamb(s) and to allow the ewe to provide adequate milk during lactation.

The average daily milk yield of hair sheep in the Caribbean ranged from 250 - 630 g over a 4 to 12 week period (Table 2). The average daily milk yield for Barbados Blackbelly ewes over an eight week period ranged from 210 - 250 g/h/day, with the higher level achieved during the rainy season and from ewes suckling multiple births (Thomas, 1994). The lactation peak is reached in the second week after parturition in
the Barbados Blackbelly breed and the average length lactation is approximately 8 weeks. There is a gradual decrease in milk yield over the lactation period (Figure 3) but this trend may be influenced by number of lambs suckled and level of nutrition, among other factors. Ewes suckling more than one lamb produced more milk than those suckling singles (Figure 4).

Table 2  Mean daily milk yield of Hair Sheep in the Caribbean

<table>
<thead>
<tr>
<th>Reference</th>
<th>Breed</th>
<th>Lactation length Wks</th>
<th>Mean milk yield (g/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butterworth et al.(1968)</td>
<td>Blackhead Persian</td>
<td>12</td>
<td>630</td>
</tr>
<tr>
<td>Combellas (1979)</td>
<td>West African</td>
<td>8 - 12</td>
<td>590</td>
</tr>
<tr>
<td>Gonzales &amp; De Alba(1979)</td>
<td>Peliguey</td>
<td>6</td>
<td>520</td>
</tr>
<tr>
<td>Thomas (1994)</td>
<td>Barbados Blackbelly</td>
<td>4</td>
<td>250</td>
</tr>
</tbody>
</table>

Source: Combellas, (1980); Thomas, (1994)

Figure 3  Lactation curve of Barbados Blackbelly ewes during two to four weeks
In addition to the selection methods mentioned earlier, the morphological traits of the udder, i.e. length, width and transverse circumference, all have positive effects on the ewes' milk yield and could be used in the selection process to select ewes for high milk yields and effective lamb rearing.

4.7 Milk Composition
The total solids content of sheep milk is about 20% which is much higher than either cow's or goat's milk — both have total solids content of about 13 percent. Table 3 shows the nutritional composition of ewe's milk for Barbados Blackbelly sheep and other hair type sheep in the tropics. The milk produced in the first few days after lambing is known as colostrum. It is much thicker than normal milk and should be fed for the first three days after birth. Colostrum stimulates the alimentary system and confers an initial immunity to disease on the lambs.

Table 3 Composition of ewe's milk in the tropics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Barbados Blackbelly %</th>
<th>Other Hair sheep %</th>
<th>Range %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total solids</td>
<td>16.1</td>
<td>19.3</td>
<td>12.5 - 20</td>
</tr>
<tr>
<td></td>
<td>16.0 - 24.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fat</td>
<td>5.0</td>
<td>7.6</td>
<td>1.2 - 7.7</td>
</tr>
<tr>
<td></td>
<td>5.0 - 12.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protein</td>
<td>8.2</td>
<td>5.5</td>
<td>5.0 - 11.8</td>
</tr>
<tr>
<td></td>
<td>4.7 - 6.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lactose</td>
<td>4.1</td>
<td>4.5</td>
<td>4.0 - 5.0</td>
</tr>
<tr>
<td></td>
<td>4.0 - 5.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.8 Lamb Rearing

It has been shown that the level of nutrition in late pregnancy and during lactation influences the level of production in ewes. During the first 3 to 4 weeks of the lamb's life, milk is essential as there is a high correlation (0.9) between milk intake and live weight gain. Within a few days from birth, young lambs will nibble at forage while grazing with their dams. However, it is not until about the second or third week of life that the lamb will consume any appreciable quantities of feed, though this is affected by the quantity of milk fed.

Colostrum is the milk produced by the ewe during the first 36 to 48 hours after lambing and is required to:

- eliminate foetal residues
- build up resistance to infection
- maintain high performance of the lamb
- reduce mortality

Since the lamb may lose the ability to absorb colostrum 15 - 24 hours after birth, it is very important that all lambs suckle immediately after birth.

If the lamb is weak, or is rejected by the ewe, it should be helped to suckle, or the ewe should be milked and the lamb encouraged to drink colostrum from a bottle to which a teat (nipple) has been attached. A baby's nipple with an enlarged hole is adequate but commercial lamb feeding teats are more suitable. Bottles and teats should be properly washed and sterilized by boiling before use as milk contaminated by dirty utensils can cause scouring (enteritis) and possible death.

Whenever the opportunity arises, an effort should be made to obtain colostrum from ewes having still births, or from cows, and store by freezing for later use. Two hundred millilitre (7 fl oz) quantities should be frozen in plastic bags for individual feedings. The colostrum should be thawed before use but should not be re-frozen.

Lamb growth rate during early life is governed largely by physiological limitations on the part of ewe, except when the lamb reaches four to five weeks old and can survive as a functioning ruminant. At this stage, energy concentration and physical form of the diet is most critical in determining growth. However, average daily gain which is usually at its highest in week 2, will start to decline from week 3 regardless of level of milk yield (Thomas 1994). Restriction of milk feeding, e.g. feeding twice or three times a day as opposed to free choice feeding, encourages early solid feed consumption.

Ideally, a palatable concentrate containing 16-18% crude protein should be offered to the lambs, free choice, starting no later than the second week of life, but preferably from the first week. Good quality forage and clean drinking water should also be provided.
Alternatively, agro-industrial by-products, when available as a local feed resource (e.g. coconut meal, cotton-seed meal, rice bran, wheat middling, poultry litter and molasses), could be combined into a complete ration and used as a substitute to concentrate feed for feeding lambs to reduce production cost (Table 4).

Table 4  Composition of by-product ration used for pre- and post-wean feeding of lambs

<table>
<thead>
<tr>
<th>Ingredient composition (%)</th>
<th>Pre-wean</th>
<th>Post-wean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat middling</td>
<td>55.0</td>
<td>45.0</td>
</tr>
<tr>
<td>Rice bran</td>
<td>13.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Poultry litter</td>
<td>0.0</td>
<td>20.0</td>
</tr>
<tr>
<td>Soybean</td>
<td>13.0</td>
<td>6.0</td>
</tr>
<tr>
<td>Molasses</td>
<td>17.0</td>
<td>17.0</td>
</tr>
<tr>
<td>Min/ vit.</td>
<td>2.0</td>
<td>2.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chemical analysis (g/kg)</th>
<th>Pre-wean</th>
<th>Post-wean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry matter</td>
<td>860.0</td>
<td>860.0</td>
</tr>
<tr>
<td>Crude protein</td>
<td>200.0</td>
<td>170.0</td>
</tr>
<tr>
<td>Calcium</td>
<td>88.0</td>
<td>140.0</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>54.0</td>
<td>39.0</td>
</tr>
<tr>
<td>Magnesium</td>
<td>39.0</td>
<td>50.0</td>
</tr>
<tr>
<td>Cost/100 lbs</td>
<td>21.22</td>
<td>17.29</td>
</tr>
<tr>
<td>Cost/unit gain</td>
<td>2.74</td>
<td>2.45</td>
</tr>
</tbody>
</table>

Source: CARDI, 1996 (unpublished data)

4.9  Artificial rearing of lambs

Lambs can be reared either naturally by the ewe, or artificially. In flocks with prolific sheep, like Barbados Blackbelly, many ewes produce litters larger than two. The extra lambs, as well as lambs that would otherwise be orphaned by rejection or death of the ewe, can be reared artificially on cow's milk, goat's milk or milk substitute (replacer). This method may be necessary to reduce the number of lamb losses. However, artificial rearing of the entire lamb crop is not recommended for commercial operations. Instead, ewes should rear at least two lambs naturally.
4.10 Fostering

Fostering can be easily done if a freshly born lamb is presented to a ewe shortly after her own parturition. Older lambs can be rubbed with fresh birth fluids or covered with the skin from the foster mother's dead lamb to aid in their acceptance. Weak lambs should be assisted to suckle the ewe.

Another way to induce a ewe which has lost her lamb to accept an orphan lamb, is to tie her to the side of the pen with three ropes or straps — one around the flank, one around the heart girth and one around the neck. Once the lamb has sucked, the ewe will normally foster it.

4.11 Artificial Milk Feeding

If foster-mothering is not possible, the lamb should be fed milk or milk substitute three times daily from 2 days to 3 weeks of age. To start the lamb on artificial milk, it is suggested that fasting for 6-12 hours be followed by access to milk. This ensures an easy transition to artificial rearing. It has been found practical for lambs to be fed from bottles, fitted with teats. During the fasting period, water should always be available to the lamb.

When the lamb is feeding well from a bottle, a change to bowl or bucket feeding can be made. It may be necessary to insert one's finger in the lamb's mouth and to hold its head down into the milk until it learns to drink. Sometimes it is convenient to group-rear lambs, though group-reared lambs may indulge in navel sucking.

During artificial rearing, the milk replacer used should be diluted and fed according to the manufacturer's direction. The normal dilution is about 250 g to a litre of water (1 lb per gallon). The daily intake of milk replacer will vary from about 1.5 litres (2.5 pt) at the start to about 2.5 litres (4.5 pt) in the third to the fifth weeks.
4.12 Artificial Colostrum

Should the lamb be unable to obtain a feed of natural colostrum, artificial colostrum can be prepared as follows:

Ingredients:
- 850 ml (1.5 pt; or 30 fl oz) cow's or goat's milk
- 1 egg
- 1 teaspoonful cod liver oil (or castor oil)
- 1 dessert spoonful sugar

Beat the egg and add it to the milk; add cod liver oil and sugar and mix thoroughly. About 170 ml (6 fl oz) of this mixture should be fed four times daily for the first 48 hours.

4.13 Weaning

Suckling should not be continued longer than is necessary. When lambs are about 6-8 weeks old and have become accustomed to dry feed, consuming about 200-250 g feed per day (7-9 oz), they can be weaned. However, under intensive management, lambs could be weaned at 28 days to allow early remating, thereby reducing the lambing interval. This early weaning inhibits growth for about 7 to 10 days during which no increase in live weight may occur. For this reason, the lambs must have access to a good palatable creep feed from about 2 weeks old as this stimulates early rumen development and allows the lamb to survive as a functioning ruminant at weaning. The weight of lambs could be used to determine time of weaning, but this could have serious consequences as lambs fed high milk diets consume very little solid food and hence rumen development may bear little relation to their weight. The rate of solid food intake would be the most desirable measure to determine time of weaning but this is difficult to measure and therefore age is used to determine time of weaning.

4.14 Lamb Mortality

Most hair sheep in the region are highly prolific (two or more lambs born per ewe lambing) and also have the ability to lamb throughout the year thereby having a high lambing frequency, producing up to three lambings in 2 years. This phenomenon produces a fairly high lamb mortality between birth and weaning and even up to 6 months.
4.15 Estimation of Age

The age of a sheep can be rapidly assessed by examining its teeth. It has three kinds of teeth, which are distributed as follows on either side of the jaw:

- in the lower jaw at the front — four incisors and further back three premolar and three molars
- in the upper jaw at the front — no incisors, three premolar and three molars.

The incisor teeth, known as ‘milk teeth’ in the young animal, when replaced by permanent teeth give a reliable estimate of age. The first milk teeth to fall out and to be replaced by permanent incisors are the centre pair followed by the adjacent pairs in succession. The probable age of a sheep with a given number of permanent incisors is given in Figure 5.

As sheep age, their permanent teeth fall out and are not replaced. This happens when sheep are about five years old and the condition is referred as ‘broken-mouthed’. Broken-mouthed sheep in grazing systems are unable to eat enough forage to maintain body condition. As a result they become thin and unproductive and should be culled to maintain flock productivity.

<table>
<thead>
<tr>
<th>Permanent incisors</th>
<th>Age Of Sheep</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Less than 1 yr 3 mths</td>
</tr>
<tr>
<td>1 Pair</td>
<td>1 yr 3 mths to 1 yr 10 mths</td>
</tr>
<tr>
<td>2 Pairs</td>
<td>1 yr to 10 mths to 2 yrs 4 mths</td>
</tr>
<tr>
<td>3 Pairs</td>
<td>2 yrs 4 mths to 3 yrs</td>
</tr>
<tr>
<td>4 Pairs</td>
<td>More than 3 yrs</td>
</tr>
</tbody>
</table>

Figure 5  Estimation of age from incisor teeth
4.16 Estimation of Weight

Low-resource farmers usually sell their sheep by sight, guessing the estimated weight of the animal. Since most farmers underestimate the weight of their animals, they invariably receive a lower price from the buyer. After carefully studying this phenomenon, CARDI scientists felt that by developing a weight tape for Barbados Blackbelly and Blackbelly type sheep, small farmers would realize more income from the sale of their sheep. In addition, using a weight tape to determine the sheep’s weight would also help the farmer to calculate the amount of ration to feed and the dose rate for medication.

![Sheep diagram](image)

Figure 6 The sheep's body showing position for taking heart girth measurement

In estimating the weight of a sheep using the weight tape, measure the heart girth — which is the distance around the body of the animal immediately behind the front legs (Fig. 6) — as there is a close relationship between this measurement and weight. In the case of the Barbados Blackbelly, using the following equations would give a fairly accurate estimate of weight. Remember that the relationship between heart girth and live weight depends on the shape of the animal, since for a given girth, a long-legged animal would be heavier than a dwarf animal.

To determine the estimated weight of the animal, follow the steps given below and find the weight by looking up the corresponding measurement in Table 5.

**Step 1**

Measure the heart girth (Figure 6) and record the measurement e.g. 25 ins (64 cm)
Step 2
Look up 25 ins (64 cm) in Table 5; estimated weight is 56 lbs (25 kg)

Table 5  Corresponding weights (kg) and heart girth (Hg) measurements of Barbados Blackbelly sheep, Barbados

<table>
<thead>
<tr>
<th>Heart girth</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>ins</td>
<td>cm</td>
</tr>
<tr>
<td>16</td>
<td>40</td>
</tr>
<tr>
<td>19</td>
<td>47</td>
</tr>
<tr>
<td>21</td>
<td>53</td>
</tr>
<tr>
<td>23</td>
<td>59</td>
</tr>
<tr>
<td>25</td>
<td>64</td>
</tr>
<tr>
<td>27</td>
<td>69</td>
</tr>
<tr>
<td>29</td>
<td>73</td>
</tr>
<tr>
<td>30</td>
<td>77</td>
</tr>
<tr>
<td>32</td>
<td>81</td>
</tr>
<tr>
<td>33</td>
<td>85</td>
</tr>
<tr>
<td>35</td>
<td>89</td>
</tr>
<tr>
<td>36</td>
<td>92</td>
</tr>
<tr>
<td>37</td>
<td>95</td>
</tr>
</tbody>
</table>

e.g:  An animal measuring 28 inches (71 cm) would be within the 67-77 lbs (30-35 kg) weight range.

An alternative to the Table is the use of the following equation:
\[ Y = -16.5 + 0.113 \times x^2 \] where \( Y = \text{wt (lbs)} \) and \( x = \text{heart girth (ins)} \)

Step 1
Using a pocket calculator square the value measured.
e.g. for a heart girth of 25 ins: 25 ins \( \times \) 25 ins = 625 ins\(^2\)

Step 2
then multiply that value by 0.113
\[ 625 \times 0.113 = 72 \text{ ins}^2 \]
Step 3
To find the weight, subtract 16.5 from the calculated value at Step 2 (72) and the result will give the estimated weight of the animal (56 pounds):

\[ 72 - 16.5 = 55.5 \]

Round off your answer to the nearest whole number e.g. 56 pounds.

Remember that calculated weight is only an estimate of the animal's live weight and in some cases the estimated weight may not appear in the Table but may be within a given weight range (see example below). The estimates, based on this equation, must be used as a guide, as the weight tape based on this equation will be breed specific, only applicable to Barbados Blackbelly breed and Barbados Blackbelly type.

N.B: The weight tape has an error factor of 2-3 pounds and has been developed as a tool is not 100% accurate.

4.17 Housing - facility and equipment requirements
The Barbados Blackbelly sheep may be reared in confinement or they may be grazed during the day and confined at night. With either system, feed and water space must be made available. The type of housing required depends on the system of management. However, sheep thrive better in an environment which is neither too hot nor too cold, is reasonably dry and is not muddy. In extensive systems of sheep production, the only form of housing is a simple shelter which should:

- be dry and draft free but well ventilated
- provide for adequate and proper feeding of forage, concentrate and water
- have adequate night/security lights, particularly during the lambing area
- allow for a high degree of sunlight into the building.
Table 6  Feeder, waterer and shelter space requirements

<table>
<thead>
<tr>
<th>Situation</th>
<th>Space required</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Feeder space</strong></td>
<td></td>
</tr>
<tr>
<td>Group fed:</td>
<td></td>
</tr>
<tr>
<td>Ewes</td>
<td>16 - 20 inches (41 - 51 cm) per head</td>
</tr>
<tr>
<td>Growing lambs</td>
<td>9 - 12 inches (23 - 31 cm) per head</td>
</tr>
<tr>
<td>Lamb creep space</td>
<td>1.75 sq.ft (0.16 sq.meters) per head</td>
</tr>
<tr>
<td><strong>Waterer space</strong></td>
<td></td>
</tr>
<tr>
<td>Automatic bowls:</td>
<td></td>
</tr>
<tr>
<td>Mature ewes, ewes with lambs</td>
<td>45 per bowl</td>
</tr>
<tr>
<td>Growing lambs</td>
<td>65 per bowl</td>
</tr>
<tr>
<td>Tank waterers</td>
<td>20 - 30 head per ft. tank perimeter</td>
</tr>
<tr>
<td><strong>Shelter space</strong></td>
<td></td>
</tr>
<tr>
<td>Communal pens:</td>
<td></td>
</tr>
<tr>
<td>Ewes</td>
<td>12 sq.ft (1.3sq. meters) per ewe</td>
</tr>
<tr>
<td>Ewes with lambs</td>
<td>14 sq.ft (1.7sq.meters) per ewe</td>
</tr>
<tr>
<td>Growing lambs</td>
<td>8 - 10 sq.ft (0.75 - 0.93sq. meters) /head</td>
</tr>
<tr>
<td>Lambing pens</td>
<td>4ft x 4ft x 3ft (122 x 122 x 91cm)</td>
</tr>
</tbody>
</table>

The range of housing from which to choose may be confusing but a good operator can make any system work. The most expensive facilities do not necessarily give the best returns. Housing, therefore, should be a compromise between that which is most comfortable and healthy for the animals and that which is most convenient and economic for the farmer.

Table 6 could be used as a guide for housing facilities whether the sheep are kept on a small scale or as a commercial operation. Lamb pens should be cleaned and disinfected whenever they are emptied and before being used for another group of lambs.

5.0 FEEDING MANAGEMENT

In tropical areas, forage availability decreases during the dry season and this induces body weight and body composition changes. Sheep are natural grazers and are basically gregarious, which makes them relatively easy to control through herding on natural
pastures and farm holdings. They prefer short grass and have difficulty eating coarse grass. As selective grazers, they can be run to good advantage with other species of livestock, especially goats and cattle.

5.1 Conventional feeding
Sheep can be reared under intensive, semi-intensive or extensive production systems depending on the resources of the farmer. Intensive production systems involve large capital outlays making these systems uneconomical. Whether sheep are kept under any of the above-mentioned systems on a small scale or as a commercial operation, they can be fed in the conventional way using commercial rations at the recommended rates. Table 7 can be used as a guide.

Table 7  A practical guide to feeding ewe lambs and mature ewes

<table>
<thead>
<tr>
<th>Period</th>
<th>Ewe lambs</th>
<th>Mature ewes</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-6 wks. before mating</td>
<td>Forage + 300 g ewe ration</td>
<td>Forage +200 g ewe ration</td>
</tr>
<tr>
<td>Pregnancy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>First 3 months</td>
<td>Forage + 300 g ewe ration</td>
<td>Forage + 200 g ewe ration</td>
</tr>
<tr>
<td>Last 6 weeks</td>
<td>Forage + 450 g ewe ration</td>
<td>Forage + 400 g ewe ration</td>
</tr>
<tr>
<td>Lactation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Singles</td>
<td>Forage + 450 g ewe ration</td>
<td>Forage + 400 g ewe ration</td>
</tr>
<tr>
<td>Twins</td>
<td>Forage + 600 g ewe ration</td>
<td>Forage + 500 g ewe ration</td>
</tr>
</tbody>
</table>

Source: Osuji (1979)

Silage or cane tops can replace the forage. If sour or Antigua hay grass is fed, increase the ewe ration by 100g. If legumes are available, the level of supplementation could be reduced by 75 g.

5.2 By-product feeding
In small scale operations producing meat for home consumption or periodic sale, the ewe can be bred to lamb in the rainy season when forage in plentiful. During this season when forage is plentiful it should be conserved either as hay or as silage for use during the dry season. However, the use of agro-industrial by-products to make complete diets is recommended, as few by-products make complete diets in their own right. Dry season feeding of grazed or zero-grazed sheep on one of the by-product rations in Table 8 is recommended and under well-managed systems can produce a marketable animal in 6 to 8 months.
Under the semi-intensive and extensive systems of production, the cost per unit gain is much lower than the intensive system, even if the by-product ration is used in all systems. These by-product rations (Table 8) were formulated to produce average daily gains of 150-200 g and had digestible energy (DE) levels of 3.3 Mcal/kg. When choosing by-products for ration formulation the farmer needs to consider availability, price and ease of use. Availability is a critical factor, as the farmer has to be sure of a reliable and regular supply.

The need for supplementary feeding cannot be disputed, but must be weighed against the difficulty of implementing it in practice, this should not be underestimated. In the semi-intensive system, sheep supplemented with 250 -500 g of by-product ration (Table 7) at strategic times i.e. last 4-6 weeks of gestation and during lactation, produced lambs with average daily gain of 115 g.

In the rainy season when forages are readily available, sheep reared under the semi-intensive system could be reared extensively with supplementation only during the period mentioned, without compromising lamb birth weight.

Table 8  Approximate composition (%) of by-product rations and molasses/urea block

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>By-product ration 1</th>
<th>By-product ration 2</th>
<th>Molasses/urea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pollard</td>
<td>41</td>
<td>40</td>
<td>25</td>
</tr>
<tr>
<td>Rice Bran</td>
<td>0</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Poultry litter</td>
<td>40</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>Molasses</td>
<td>17</td>
<td>28</td>
<td>35</td>
</tr>
<tr>
<td>Min/ vit</td>
<td>2</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Cement</td>
<td>0</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Urea</td>
<td>0</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Quick lime</td>
<td>0</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>Crude protein (%)</td>
<td>14.5</td>
<td>16</td>
<td>22.1</td>
</tr>
<tr>
<td>Cost/kg (Bds$)</td>
<td>0.24</td>
<td>0.26</td>
<td>0.62</td>
</tr>
</tbody>
</table>

In the extensive system, molasses/urea blocks (Table 8) could be fed ad lib to increase the dry matter intake and digestibility. Dry season feeding is very critical and most animals kept extensively lose weight as a result of low nutritive value of the forages available during this period.
Because of the high fibre in the diet, degradation in the rumen is very slow and as a result the nutrients are released slowly. High fibre diets fill up the available space in the rumen and greatly reduce the animal's ability to eat. The use of molasses urea blocks, especially during the dry season, will help increase the digestibility of the forages/fibre resulting in faster turn-over in the rumen. Sheep will consume approximately 200 g/day of MUB and this will also have a significant on effect the reproductive performance of hair sheep.

5.3 Water
Although water is not a nutrient, it is essential and should be available at all times to meet body requirements and provide for production (meat/milk). Water requirements vary according to age, body condition, production level and prevailing ambient temperature.

6.0 HEALTH MANAGEMENT
6.1 Introduction
The major health problem in sheep in Barbados is internal parasites and to a lesser extent the sheep Nasal 'bot' fly (Oestrus Ovis). The major parasites responsible for unthriftiness and death of lambs are Gastrointestinal nematodes (GIN), such as Haemonchus, Oesophagostomum and Trichostrongylus, tapeworms (Cestodes), Moniezia expansa and the protozoan parasite Eimeria spp. better known as coccidia.

Although information and recommendations for treatment are available, many farmers do not follow a definite routine for treatment of their animals. In addition, the present packaging size of the anthelmintics (dewormers) for treatment also contribute to the limited or non-use of dewormers by farmers. The frequency of deworming practised by farmers ranges from every three weeks to once a year with varying results.

The number of parasites infecting sheep varies with the season. Eggs hatch more readily and immature worms develop faster in the rainy season. As a result, the parasites' life cycles are shorter and more larvae survive in the rainy season, leading to an increase in the worm burden in sheep in the wet season.

Furthermore, the activity of internal parasites in sheep is affected by the variation in the wet and dry seasons, with parasite development normally slowing down in the dry season. Infective larvae that enter the sheep just before the onset of the dry season may stop development and remain in the larval stages (Hyperbiosis) until the onset of the rainy season when a gradual increase in number of worm cases will be observed.
A worm control programme should therefore include suppressive anthelmintic treatment during the times of the year when the eggs shed by the sheep are likely to develop into infective larvae in large numbers. Therefore, ewes should be dewormed before and after lambing and the lambs at weaning, to reduce mortality to acceptable limits particularly during the wet season.

Health management is extremely important in sheep farming in the tropics as this helps to increase profits by reducing disease and maximizing productivity. Under traditional husbandry systems, 25 - 30% of lambs born are lost within the first six months. Among adults animals annual mortality ranges from 5 -10%.

Disease is not the only cause of death, as nutrition could also be a major factor. In most cases, a combination of these causes of ill health and subsequent death are connected, e.g. because of poor feeding, a disease that a well-fed animal would have survived can often become fatal to an under-fed animal. In addition, parasites, respiratory and digestive disorders combine to aggravate the poor health of sheep.

6.2 Pest and Diseases

6.2.1 Internal Parasites

Sheep are very susceptible to internal parasites, which prove to be one of the most important factors affecting production. Parasites are living organisms which live on other living organisms (hosts) during a part of their life cycle. Some of these parasites are on the inside of the body (internal), others are on the outside (external). They obtain nutrients from the hosts in order to survive while the hosts ability to survive is reduced. Sheep production in the tropics is severely threatened by internal parasites; both worms and cocci are of major economic importance. Infestation with parasites results in unthrifty animals showing poor growth rates and in extreme cases, can cause the death of young animals. However, these outbreaks of worm infestation could be controlled with proper nutrition and management thereby reducing the dependency on, and frequency of deworming. Table 9 shows the incidence of worm infestation by species, in Barbados, during 1991 and 1993.
Several species of nematodes (roundworms) and cestodes (tapeworms) can live as parasites in sheep. Sometimes a sheep is infested by only one species of parasite, but usually it is host to more than one. The eggs of these parasites are fairly easy to identify under the microscope. The eggs fall to the ground with the sheep’s droppings where eggs find favourable conditions, produce larvae that are ingested by the sheep together with grass (Figure 7). The wet pastures and the stocking rate are predisposing factors that lead to massive infestation of sheep.

![Generalized gastrointestinal nematodes life cycle](image)

**Figure 7** Generalized gastrointestinal nematodes life cycle

<table>
<thead>
<tr>
<th>Parasitic species</th>
<th>CSPM Farmers</th>
<th>Other Farmers</th>
<th>Total # of farmers</th>
</tr>
</thead>
<tbody>
<tr>
<td>GIN</td>
<td>62</td>
<td>65</td>
<td>127</td>
</tr>
<tr>
<td>Eimeria</td>
<td>39</td>
<td>151</td>
<td>190</td>
</tr>
<tr>
<td>Moniezia</td>
<td>10</td>
<td>17</td>
<td>27</td>
</tr>
<tr>
<td>Strongyloides</td>
<td>15</td>
<td>13</td>
<td>28</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>126</strong></td>
<td><strong>246</strong></td>
<td><strong>372</strong></td>
</tr>
</tbody>
</table>

Source: CARDI and Ministry of Agriculture Veterinary Laboratory
6.2.1.1 Signs of parasitism

Signs of parasitism vary with the severity of infection and the age of the host animal. Anaemia (loss of blood) is the most important sign while other signs are lack of appetite and general unthriftness, bottle jaw, a numps-like swelling under the lower jaw, pot-belly, rough hair coat, watery and sometimes bloody stool as in the case of coccidiosis, and animals that are thin and dehydrated. Depending on the severity of anaemia, the lining of the mouth, the lining inside the eyelids and vulva become pale pink to chalky white. Some sheep develop a watery stool or diarrhoea which is caused by the parasites damaging the membrane of the walls of intestines, thus preventing proper absorption of the nutrients from the digested feedstuffs.

6.2.1.2 Treatment

It is advisable, where possible, to have faecal examination done to identify the species and level of infestation before any treatment is administered. Treatment usually consists of oral administration of anthelmintics (dewormers) depending on species and level of infestation. There are several brands of anthelmintics available for use and these should be administered according to the manufacturers recommendations. Mention will be made of a few for reference only — Valbazen®, Panacur® and Tramisol® are all safe and effective against most stomach worms, tapeworms, liver flukes and lungworm. However, do not use Valbazen® in the first trimester of pregnancy as it may cause the animal to abort.

6.2.1.3 Management practice

Control of these parasites can be achieved by different means as management is as important as medication in controlling parasites. Measures to consider are:

- keep pastures clean by practicing proper rotation of animals in separate groups
- keep grass off the ground
- put grass in racks
- keep sheep, especially lambs, off communal pastures which are usually worm infested
- worm sheep regularly, before, during pregnancy and after lambing
- worm lambs at weaning and then every 21 days up to about 6 months of age.

Generally ewes and lambs would graze before older animals in the flock. Mild infections of internal parasites can depress the growth rate of lambs while heavier infections can lead to their death.
Animals should be deworming regularly, especially during the rainy season and just before lambing, as there is a sharp increase in worm load during this time. Lambs are more susceptible to internal parasites than adult sheep, and the greatest threat occurs if the ewes output of parasitic eggs go up soon after lambing. Laboratory examination of faecal samples by the veterinary services will give an assessment of infestation and the deworming programme can be based on the results of these examinations.

6.2.1.4 Seasonal variation in worm load
The number of parasites infecting sheep varies with the season. Eggs hatch more readily and larvae develop faster in the rainy season. As a result, the parasites life cycle is shorter with more larvae surviving in the rainy season leading to an increase in the worm burden.

6.2.1.5 Gastrointestinal nematodes (GIN)
These are major internal parasites affecting sheep production in the Caribbean. They are blood-sucking and live in the stomach, intestines and lungs of sheep. With the exception of hookworms, lungworm and threadworm, GIN have similar direct life cycles. These 'worms' produce eggs which are passed out in the manure. In the rainy season, they hatch producing larvae which reach the infective stage within four to six days and can live on pasture for up to 6 months.

Sheep become infected by eating grass contaminated with the larvae. Once consumed the larvae develop into adult worms in the stomach of the animal in 14 to 28 days where they survive for many months producing thousands of eggs which pass out daily in the manure.

The larvae of the hookworm, another species of GIN, can infect the animal by boring through the skin as well as by being eaten in contaminated grass. Following infection, the larvae are transported via the blood to the lungs from where they migrate to the intestines.

6.2.1.6 Tapeworms (Cestodes)
These are very common in sheep (Moniezia spp) and are found in small intestines. The most frequent hosts are sheep, especially lambs. Tapeworms require an intermediate host to complete their life cycle. This intermediate host, irrespective of the parasite species, is always a microscopic oribatid mite. These mites live on and in humus on the soil surface, and prefer damp, shaded areas. The mites eat the eggs of the parasites which develop into tiny cysts inside the mites; sheep become infected when they eat the
mites, as they graze. The immature tapeworm is then released from the mite and attaches itself to the wall of the small intestines where it develops into the adult worm.

Although these parasites seldom cause serious problems in adult animals, lambs are highly susceptible to infestation. Immunity to tapeworms is develop with age, as sheep over one year old seldom harbour adult tapeworms or have only small numbers of these parasites.

6.2.1.7 Coccidiosis
This is an intestinal disorder caused by one cell microscopic parasitic protozoan *Eimeria spp.* These protozoa live in the cells of mucosa of the large intestines. They are present in all animals, but are species specific i.e. the type found in chickens will not be the same as those found in sheep. The parasitic cycle does not need any intermediate host, as the sheep are infested by absorbing coccidia excreted by sick animals. It is very common in sheep in the tropics and the number of cases, like other cases of internal parasites, usually increase during the rainy season (Figure 8).
The disease is becoming more prevalent as more intensive systems of sheep production are practiced. Many stages of coccidia develop in the intestinal walls of the infected animals, causing extensive damage and impairing the normal function of the gut.

Symptoms: The principal symptom is diarrhoea, often containing blood. This lasts for 2 to 3 days, then disappears, except in severe cases, where it persists resulting in emaciation (loss of weight) and sometimes death. Diagnosis can be confirmed by laboratory examination of faeces. The clinical form of the disease occurs mainly in lambs.

Treatment: When coccidiosis is confirmed, all lambs should be drenched with the appropriate medication e.g. Amprol® or Sufa 33® at the manufacturers recommended rates.

Prevention: This disease is difficult to control as many animals harbor coccidia without showing signs of illness but with the consequent risk of infecting lambs. Systematic treatment of all lambs and cleaning and disinfecting sheep houses are two possible strategies for preventing this disease.

6.2.2 External Parasites
These are largely ticks and lice. Control is obtained by good husbandry practices and spraying with the appropriate acaricide as needed.

Mange in caused by mites which burrow into the skin to lay eggs. This activity causes itching and the resultant scratching aggravates lesions causing:

• exudation (skin is moist)
• excessive scab formation
• hair loss and thick wrinkled skin

Infected animals should be isolated immediately and treated with a mange preparation.

6.2.2.1 Sheep Nasal 'Bot' Fly
The sheep nasal fly *Oestrus ovis* deposits its larva in the nasal passages of sheep where they migrate up the nasal passage and develop into larger maggots (up to 2 cm in length). The larva then crawl back down the nasal passage and are ejected when the sheep sneezes. They then pupate, producing more flies and the cycle continues.
Symptoms: Thick, purulent nasal discharge, sneezing and head shaking. The fly disturbs the sheep which rush around, keep their noses down to the ground and stop eating. These attacks seem to occur in late morning or early afternoon. Generally, only the nasal discharge and fly worry occur, but at times larvae can cause damage to the skull and brain.

Treatment: The injectable drug Ivermectin® or Auramycin® used as a drench seem to be the only means of control.

6.2.2.2 Nutritional or metabolic diseases
Some important diseases arise as a result of their environment or of the way they are managed. These include certain infectious diseases, metabolic disturbances, nutritional deficiencies and imbalances. These disorders are not generally a serious problem, except in intensive production systems. Metabolic disturbances usually arise when there is an imbalance between dietary intake and production offtake, e.g. milk fever associated with a sudden drop in blood calcium especially at lambing. Other examples that occur are ketosis (pregnancy toxaemia), acidosis and bloat.

6.2.2.3 Pregnancy toxaemia
This disease occurs only within the last few weeks or days of pregnancy and is usually seen when the sheep is carrying two or more lambs or when the ewe is very fat. It is caused by the sudden extra demand for energy by the fast-growing lambs in the pregnant sheep.

Prevention and Treatment: Do not allow fat ewes to lose weight in late pregnancy and try to keep them from becoming overly fat earlier in the pregnancy. If the ewe lies down and cannot stand, treatment is usually not successful unless she delivers at that time. Treatment with propylene glycol at 60 to 90 ml twice a day will help, along with some grain.

6.2.2.4 Bloat
Bloat stems from the animal's inability to get rid of gas produced in the rumen. This gas accumulates and causes the sheep to have a full left flank which juts out and sounds like a drum when thumped. The gas can be free or mixed with the feed in the rumen (frothy bloat). If the gas is not relieved, it will cause extreme discomfort and death from a reduced ability to exchange oxygen in the blood.
Treatment: Force the sheep to stand and walk and tie a rope or stick in the mouth for it to chew on. This stimulates saliva and helps to reduce bloat. Seek veterinary assistance.

7.0 REFERENCES