Australian goat manual for Malaysian farmers
A guide to successful goat production from Australian goats in Malaysia
Australian goat manual for Malaysian farmers

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## Definitions

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ADG</td>
<td>Average Daily Weight Gain</td>
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<tr>
<td>Ca</td>
<td>Calcium</td>
</tr>
<tr>
<td>CP%</td>
<td>Crude Protein Percentage</td>
</tr>
<tr>
<td>DM</td>
<td>Dry Matter</td>
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<tr>
<td>DMI</td>
<td>Dry Matter Intake</td>
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<tr>
<td>g</td>
<td>Gram</td>
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<td>Kg</td>
<td>Kilogram</td>
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<tr>
<td>mg</td>
<td>Milligram</td>
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<tr>
<td>MJ</td>
<td>Megajoules</td>
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<tr>
<td>MJ/kg</td>
<td>Megajoule per kilogram</td>
</tr>
<tr>
<td>MJME</td>
<td>Metabolisable Energy</td>
</tr>
<tr>
<td>MJME/kg DM</td>
<td>Energy in Dry Matter</td>
</tr>
<tr>
<td>Mn</td>
<td>Maintenance Requirement</td>
</tr>
<tr>
<td>P</td>
<td>Phosphorus</td>
</tr>
<tr>
<td>PKC</td>
<td>Palm Kernel Cake</td>
</tr>
<tr>
<td>PKE</td>
<td>Palm Kernel Expeller</td>
</tr>
</tbody>
</table>
Introduction
Section 1 - Introduction

Australia is a supplier of high quality goats to the international goat breeding and meat markets.

Malaysia is a very important market for Australian goat producers and this manual has been developed to assist Malaysian goat farm managers and workers.

Goats in Malaysia

Many breeds of goats are available to farmers in Malaysia. The local goat has served farmers well in the past however intensive farming has lead to inbreeding and reduced production performance. To combat this, new genetics from Australia in the form of live goats are now being introduced.

Australia offers a wide range of goat types and breeds including those suited to meat production under shedded conditions in Malaysia.

Breeds of goats in Australia

The Australian rangeland goat

Although not native to Australia, rangeland goats have evolved over hundreds of years from escaped domestic goats and now inhabit many parts of Australia. Being very hardy, rangeland goats are able to survive on low quality feed, reproduce efficiently and are good mothers.

Boer goats

Boer goats are a specialist meat breed introduced to Australia from South Africa.
Boer goats and their crosses are defined by the Boer Goat Breeders Association of Australia as:

- **Full blood Boer goats**
  Registered with certificates confirming that both males and females are descended from registered animals imported from Africa.

- **Pure bred Boer goats**
  Progeny of registered males or females joined to fifth cross goats or more.

  *Cannot be full blood.*

- **Cross bred Boer goats**
  Expressed as percentage full blood Boer as follows:

  - $F_1 = \text{First cross} = 50\%$ Boer blood
  - $F_2 = \text{Second cross} = 75\%$ Boer blood
  - $F_3 = \text{Third cross} = 87.5\%$ Boer blood
  - $F_4 = \text{Fourth cross} = 93.75\%$ Boer blood
  - $F_5 = \text{Fifth cross} = 96.875\%$ Boer blood

F1 males or females usually have horns that sweep backwards and at least 50% of any specific group will be totally white.

Some animals will show black or brown body colour on a white background.

As purity increases, the male offspring will move towards a Boer red headed look that should be prominent by the third of fourth cross.

Boer characteristics include large mature weights, high growth rates and high fertility. Does can be joined from about 200 days of age and reach maturity at about 20 to 24 months.

**Dairy breeds**

- **Anglo Nubian**
  Dual purpose breed with good growth and useful milk production. Limited availability.

- **Australian Brown**
  Good milk producer. Limited availability.
• **Australian Melaan**
  Hardy and disease resistant good milk breed. Limited availability.

• **British Alpine**
  Hardy and active goat. Limited availability.

• **Saanen**
  Most common dairy breed in Australia with high volume milk production. Available in reasonable numbers.

• **Toggenburg**
  Good milk producer. Limited availability.

**Fibre breeds**

• **Angora**
  Produce the luxury goat fibre mohair. Available in reasonable numbers.

• **Cashmere**
  Produce the fine luxury fibre cashmere. Limited availability.

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**What is hybrid vigour?**

Hybrid vigour occurs when goats from different genetic breeds are cross bred. When joined, the progeny will usually outperform the parents.

By using hybrid vigour, goat farmers are able to improve the performance of their goat herd with minimal cost and effort, especially in the traits of fertility and growth rate which are critical to profitability.

In Australia, cross breeding for increased meat production often occurs between rangeland does and Boer bucks.
Farm planning
Section 2 - Farm planning

Farm planning is vital to ensure that a farm is properly equipped to deal with goats. Farm layout should be considered before goats arrive but can also be modified at later stages to improve the operation.

Housing of goats in Malaysia

In high rainfall zones such as Malaysia, goats cannot be kept on the ground without high losses from parasites and disease. It is therefore vital to have the right shelter available for housing goats. This should include:

- An elevated shed with wide roof to protect goats from heavy rainfall.

- A slatted floor with sufficient space below to allow the waste to be cleared out easily.

Air flow is important to disperse the smell and ammonia fumes which can irritate the eyes and lungs of the goats. Removing this waste regularly also prevents flies and biting insects from gathering in large numbers; annoying the goats and potentially spreading disease.

Several important components of well planned farms for shedded goat production are presented below.

Ensuring that there is ample on farm water storage is an important component of farm planning. A farm should have two day’s water supply in case of emergency.

A typical raised goat shed in Sabah. The elevated floor allows for ventilation and waste to be easily cleared from under the shed.
Adequate clearance below the shed allows for good ventilation and waste to be cleared from under the shed easily.

Good farm planning allows important items such as loading ramps to be designed and located in the best possible place in the farm layout.

The slatted floor allows the manure and urine to pass through while providing comfortable footing for the goats. A good clean water supply to each pen is also important.

Shed design is important to ensure that goats have good access to feed troughs while the slatted floor allows spill feed, manure and urine to pass through to the ground below for clear out.

A feed trough positioned between two pens.

An alternative feed trough design.
Water Supply

A critical aspect of farm design is water supply. In a tropical climate like that of Malaysia, it is vital that goats have ready access to good quality water.

Goats will drink 10%-15% of their body weight in water each day so a 40kg goat will drink 4-6 litres of water each day.

A farm should always have two day’s supply of water on farm in case of emergency. In order to maintain good water quality, water troughs in all pens should be drained and cleaned regularly.

Quarantining new stock on arrival

New stock must be quarantined on arrival in order to manage any new diseases carried by these goats. Necessary procedures are described below:

1. All new arrivals should be unloaded into designated quarantine pens which ideally have been empty for one month, recently cleaned and preferably sprayed with a disinfectant.

2. These pens should be isolated from other goats from other shipments. Different workers should be assigned to these pens to avoid cross-contamination.

3. New arrivals should remain in quarantine pens for a minimum of 14 days and be carefully inspected each day for signs of illness or disease.
Section 2 - Farm planning

Special care for goats upon arrival at farm

New stock being introduced to the farm after long periods of transport may be stressed and need special attention in addition to the recommended quarantining.

Their introduction must be made as smooth as possible.

Recommended treatments include:

- Ample space to allow room to rest without being disturbed by other goats.

- Always separate bucks and does so tired does are not mated by bucks. Bucks may need to be individually segregated if fighting occurs.

- Constant supply of fresh, uncontaminated water.

- Provide adequate quantities of the most palatable feeds to encourage new arrivals to begin eating as soon as possible. Refer to Introduction to feed rations.

- Manage the environment to prevent cold or heat stress. Provide adequate shelter with good ventilation.

- If the goats are very tired and lying down for extended periods, bedding such as grass, leaves or empty feed bags may hasten recovery.

- Examine all new stock carefully and frequently for signs of injury or disease. If problems are identified treat them quickly as the stress of transport will have reduced the animal's body defences.

- Diarrhoea can be due to change in diet (mild diarrhoea with no blood) or disease.
Sick, distressed animals exhibiting blood in diarrhoea are likely to be diseased and these goats must be treated quickly.

- Sick animals should be treated and isolated from all other goats, including other new arrivals, to ensure that they do not spread the disease.

- Where possible, purchase newly imported animals after they have completed their quarantine and acclimatisation period at the government farms.

Transport of goats over long distances can result in injuries and this can lead to the development of diseases.

The best way to minimise this is to use transport companies with suitable vehicles, often with bedding on the floor, security to prevent escape, adequate shelter and a good reputation for the safe handling and delivery of stock.

The most common diseases and their treatments are discussed in *Section 5 - Health*.

**Introduction to feed rations**

To encourage eating, new arrivals should be offered a “Starter” ration consisting of at least 75% freshly chopped green forage, such as Napier grass, native grass or forage corn.

The remainder of the ration should consist of introductory levels of higher energy feeds such as copra meal, palm kernel meal, cassava root by-products or rice bran.

Beware of diarrhoea from sudden change of diet. This can be averted by mixing the new ration with what the goat is used to either in transit or at origin.

Highly palatable chopped feed is recommended as a “Starter” feed for newly arrived goats.

**General health care**

Inspect all goats every day, particularly new arrivals, for signs of poor health. Sick goats may:

- Appear depressed and hold their heads lower than normal.

- Be less responsive and be not as curious as other goats.
• Have less “gut fill” than other goats.

• Come to the feed trough more slowly.

• When suffering from infections causing fever, have rectal temperatures of over 40.5°C and respiratory rates higher than normal.

Any sick goats should be placed in designated sick pens. These pens should have:

• Effective shelter from wind, rain and sun.

• Clean and comfortable pen surfaces with no missing or broken floor slats.

• Reduced population densities (approximately 50% more space than normal pens).

• Free choice of fresh chopped forage as well as a “Starter” type ration as the main feed.

• Regular monitoring with goats treated as required according to veterinary protocols (refer Section 5- Health).

• Be isolated from the main pens, including sick pens, so as to avoid the spread of disease.

During export preparations, imported goats will have been treated for parasites.

Parasite resistance may however mean some goats are still infested and if new consignments of goats appear to be suffering from internal parasites, poor condition and scouring, a Faecal Egg Count test should be conducted to confirm the presence of a worm problem. These goats should be treated immediately.

Goats purchased locally or those that graze pasture should be assumed to be infected and treated accordingly.
Breeding and raising goats
Section 3 - Breeding and raising goats

Goat husbandry annual cycle
Animal husbandry is a term used to describe the breeding and raising of livestock.

The goat husbandry annual cycle can incorporate the following key events and farm activities:

Birth
Monitor kidding carefully and provide does with the best possible conditions, including a ready supply of high quality feed and adequate shelter for newborn kids.

Lactation
During early lactation keep the body condition of the doe at Body Condition Score 2 or above to prevent diseases such as Ketosis. Provide a ready supply of feed to encourage milk production.

Weaning
Weaning is stressful for the kids and the does. Condition kids for weaning by periods of separation pre-weaning.

“Nurse-does” which have no kids may be provided to comfort the kids.

Vaccinate kids at weaning and ensure males and females are separated prior to puberty which can be as young as four months.

Growing kids
Provide kids with a high quality, balanced diet. Boer kids can grow at between 100 and 200 grams per day if well cared for.
**Dry does and joining**

If the doe becomes pregnant in her first season (usually 4-7 months old), she will struggle to reach her potential mature weight.

Does are more fertile on the second cycle and both does and bucks will be more fertile if nutrition is good.

Ensure bucks are in good condition for joining including well trimmed feet and sound mouths and testicles.

A buck to doe ratio of 3% for mature bucks, more for younger males, should be adopted.

Do not leave the bucks in permanently. Rest them between joining to allow them to recover their strength.

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**Pregnancy**

Provide adequate nutrition throughout pregnancy and increase feed supply in the last six weeks of pregnancy.

Avoid overfeeding does in early pregnancy as this can lead to kidding difficulties and pregnancy toxaemia. Vaccinate and treat for parasites prior to kidding.

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Bucks should not be left with does all the time but rather, introduced to does for a defined joining period.
### Determining the age of goats

The approximate age of a goat can be determined by counting the incisor teeth:

<table>
<thead>
<tr>
<th>Age</th>
<th>Description</th>
</tr>
</thead>
</table>
| 0   | • No permanent incisor teeth (milk teeth only)  
     |   • Birth to approximately 15 months of age |
| ML0 | • No permanent lower molar teeth.  
     |   • Birth to approximately 5 months of age. |
| ML1 | • Evidence of eruption of first permanent lower molar teeth (4th cheek teeth).  
     |   • Erupts at approximately 3 to 5 months of age. |
| 2   | • Evidence of eruption of 1 but not more than 2 permanent incisor teeth.  
     |   • First tooth erupts at approximately 13 to 21 months of age. |
| 4   | • Evidence of eruption of 3 but not more than 4 permanent incisor teeth.  
     |   • Third tooth erupts at approximately 18 to 24 months of age. |
| 6   | • Evidence of eruption of 5 but not more than 6 permanent incisor teeth.  
     |   • Fifth tooth erupts at approximately 22 to 32 months of age. |
| 8   | • Evidence of eruption of 7 or more permanent incisor teeth.  
     |   • Seventh tooth erupts at approximately 27 months of age. |

*Source: AUS-MEAT livestock language*
**Body condition scoring**

Body condition scoring (BCS) is a rating of how fat the animal is using a score from 1 to 5 with score 1 being very thin and score 5 very fat.

This information can be used to plan activities in the animal husbandry annual cycle. For example:

- Does with a BCS 3-4 are more likely to become pregnant, conceive earlier and have more twins. Birth is likely to be easier, kids healthier and more milk produced. This is the ideal BCS for conception and kidding.

- Pregnant does with a BCS of 1 (too thin) or 5 (too fat) are likely to develop “Pregnancy Toxaemia”. Refer to Section 5 – Health for more details.

Feed should be adjusted to maintain a BCS of 2 or 3.

The diagram over the page shows how and where to condition score goats and sheep in the rib area.

<table>
<thead>
<tr>
<th>Body condition score</th>
<th>Description relating to the rib area</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Very lean, ribs felt easily; cannot feel covering tissue</td>
</tr>
<tr>
<td>2</td>
<td>Lean, ribs felt easily; with slight amount of covering tissue</td>
</tr>
<tr>
<td>3</td>
<td>Moderately lean, ribs felt with covering tissue present.</td>
</tr>
<tr>
<td>4</td>
<td>Moderately fat, ribs felt but covering tissue prominent.</td>
</tr>
<tr>
<td>5</td>
<td>Fat, ribs difficult to feel, covering tissue prominent and may feel fluid.</td>
</tr>
</tbody>
</table>
Guide to body condition scoring

Image showing the position of the 13th rib in a goat
Source: Farming Meat Goats: Breeding, Production and Marketing, Babara Vincent

Cross-section showing how to condition score by feeling the level of tissue cover at the 13th rib.
Source: Department of Agriculture (Western Australia)
**Examples of goats of various condition scores**

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
<th>Visuals</th>
</tr>
</thead>
</table>
| 1     | **Very lean** | - Body angular, narrow and slab sided.  
- Backbone raised and sharp.  
- Ends of short rips sharp and easily felt. |
| 2     | **Lean**     | - Backbone raised and barely covered. Pin and hip bones obvious and barely covered.  
- Ends of short ribs smooth but easily felt. |
| 3     | **Medium or moderately lean** | - Backbone slightly raised, smooth and rounded over top. Pin and hip bones lightly covered.  
- Ends of short ribs smooth but can still be felt.  
- Moderately rounded appearance. |
| 4     | **Moderately Fat** | - Smooth, rounded appearance.  
- Backbone can be only just felt. Pin and hip bones smooth and rounded. Ends of short ribs cannot be felt.  
- Condition score 5 is very fat. |

Adapted from: New South Wales Department of Primary Industries
Nutrition
(Feeding and fattening goats)
Section 4 - Nutrition

What and how much to feed a goat varies greatly depending on the farm production objective and available feed.

Farm objectives
The farm objectives must be identified: Most farms either concentrate on breeding goats requiring a constant supply of lower quality feed with more forage, or fattening goats for slaughter requiring good quality feed and more concentrates.

If objectives include both activities, they should be considered separately.

Nutrient requirements
Goats are ruminants with four stomachs, three of which contain microbes that break down feed. By providing the microbes with a balanced nutrient supply of Energy, Protein, Fibre, Minerals and Vitamins, fermentation is promoted.

There is a minimum daily requirement for each nutrient group and they must be provided in correct proportions. This is why nutritional requirements are expressed on the basis of either percentages or grams per kilogram of the total ration. Dry Matter Intake and Digestibility are also important components in considering nutrition.

Dry Matter Intake and Digestibility
Nutrients are contained in the dry portion of the ration, so it is important to know the Dry Matter (DM) content of the feed provided.

The “AS FED” quantity of feed, what is given to the animal, should be analysed as a Dry Matter quantity.

Palatability is an important characteristic of a feed. Feeds must be palatable to ensure that the nutrients within that feed are consumed.

After consumption, food is fermented and digested so the nutrients can be absorbed. Digestibility indicates the portion of the nutrient that is available to the animal, the rest becomes manure. If the ration is palatable and digestible goats should eat 2-4% of their bodyweight in Dry Matter each day.

Energy
When feeding goats in Malaysia, Energy will commonly be the most limiting nutrient. Addressing the Energy need is usually the first requirement in a feeding program.

Energy is necessary for all body functions with exact requirements depending on age, weight, average daily weight gain (ADG), stage of pregnancy or lactation and the climatic conditions.
Energy from feed depends on the **Gross Energy** content and its digestibility. Some will be lost as methane but the rest is available as **Metabolisable Energy**.

Animal requirements are assessed as Megajoules of Metabolisable Energy (MJME), while Energy in feed Dry Matter is assessed as MJME/kg DM.

**Maintenance Requirement**

The first step in addressing energy needs is to calculate the “**Maintenance Requirement**” (Mn) which is energy required to maintain a steady live weight in a “dry animal” (neither pregnant nor lactating). Table 1 indicates goat Mn in normal conditions and growth.

**Requirement for growth, pregnancy and lactation**

Once the Energy requirements for maintenance have been calculated, allowances are made for the increased requirements for the growth of weaners and young goats, plus pregnancy and lactation in does, by multiplying the Mn by an appropriate factor, as shown in Table 1.

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<table>
<thead>
<tr>
<th>Definitions</th>
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<tbody>
<tr>
<td>ADG</td>
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<tr>
<td>DM</td>
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<tr>
<td>g</td>
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<tr>
<td>Kg</td>
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<tr>
<td>mg</td>
</tr>
<tr>
<td>MJ</td>
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<tr>
<td>MJME</td>
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<tr>
<td>MJME/kg DM</td>
</tr>
<tr>
<td>Mn</td>
</tr>
<tr>
<td>Live weight (kg)</td>
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<tr>
<td>-----------------</td>
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<tr>
<td>10</td>
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<td>20</td>
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<td>90</td>
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<td>100</td>
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<table>
<thead>
<tr>
<th>Growth rate (g/day)</th>
<th>Growth Requirements – relative to Maintenance Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>Mn x 1.35, Mn x 1.20, Mn + 1.0, Mn + 0.7</td>
</tr>
<tr>
<td>100</td>
<td>Mn x 1.55, Mn x 1.30, Mn + 1.0, Mn + 0.7</td>
</tr>
<tr>
<td>150</td>
<td>Mn x 1.70, Mn x 1.40, Mn + 2.0, Mn + 1.4</td>
</tr>
<tr>
<td>200</td>
<td>Mn x 1.85, Mn x 1.50, Mn + 2.0, Mn + 1.4</td>
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<table>
<thead>
<tr>
<th>Stage of Pregnancy¹</th>
<th>Pregnancy Requirements – relative to Maintenance Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st 3 months</td>
<td>Mn sufficient, Mn sufficient, Mn sufficient, Mn sufficient</td>
</tr>
<tr>
<td>Last 2 months</td>
<td>Mn x 1.7##, Mn x 1.7##, Mn + 2.0, Mn + 1.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stage of Lactation²</th>
<th>Lactation Requirements – relative to Maintenance Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st month</td>
<td>Mn x 2.2##, Mn x 2.4##, Mn + 2.0, Mn + 1.4</td>
</tr>
<tr>
<td>Last 2 months</td>
<td>Mn x 1.8**, Mn x 2.0**, Mn + 2.0, Mn + 1.4</td>
</tr>
</tbody>
</table>

Table 1: Nutrient requirements for maintenance, growth, pregnancy and lactation

¹ Five month gestation period.
² Assuming a three month lactation, with does producing 1.5kg milk per day.
## Feed should be gradually increased to these levels, starting from two months before kidding.
** Feed should be gradually reduced to these levels, starting from the second month of lactation.
**Protein**

**Maintenance requirement**

The “Maintenance Requirement” (Mn) for protein is the amount of Protein required to maintain live weight in a dry animal.

Table 1 includes Protein requirements for maintenance. Young, pregnant or lactating goats have greater needs for protein than do animals just maintaining weight as also outlined in Table 1.

**Protein/Energy balance**

The amount of Protein supplied in the ration must balance the Energy content of the diet if rumen fermentation is to be efficient.

Much of the Protein in feed is reduced to ammonia in the rumen, providing a nitrogen source for the microbes. This combined with Fermentable Energy permits the microbes to grow and reproduce.

The flow of microbial protein out of the rumen to the abomasum and intestine provides the majority of Digestible Protein to ruminant animals.

The total dietary balance between Protein and Energy is also an important determinant of the rate of lean muscle deposition as opposed to the deposition of fat in a carcase.

A low dietary Protein to Energy ratio can lead to excess fat in the carcase. A high dietary Protein to Energy ratio can cause excess fat mobilisation and contribute to Fatty Liver Syndrome and Ketosis.

Table 2 indicates the Crude Protein required to maintain a balance between Energy and Protein.

<table>
<thead>
<tr>
<th>Metabolisable Energy (MJ/kg)</th>
<th>Crude Protein requirement* (%)</th>
</tr>
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<tbody>
<tr>
<td>13</td>
<td>16</td>
</tr>
<tr>
<td>12</td>
<td>15</td>
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<tr>
<td>11</td>
<td>14</td>
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<tr>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td>9</td>
<td>11.5</td>
</tr>
<tr>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>7</td>
<td>9</td>
</tr>
</tbody>
</table>

Table 2: Crude Protein required to maintain a balance between Energy and Protein

* Assumes 70% rumen degradability
The dietary requirements for both Crude Protein percentage (CP%) and Metabolisable Energy (MJ/kg) are much higher for younger goats and decline significantly with increasing live weight as shown in Chart 1.
**Fibre**

Fibre or roughage is required in a ration to ensure good rumen function.

The balance between roughage, Fermentable Energy and Protein is an important determinant of rumen health and therefore overall performance in growing, fattening and breeding goats. It is also a key factor in economical feeding as roughages are usually the cheapest ingredients in a ration.

A “basal ration” of forage and a small amount of concentrate can be supplemented with increasing amounts of concentrates to achieve increasing levels of performance.

Excessive roughage can be detrimental if it limits the intake of high Energy and Protein ingredients which are important in lactation diets.

For kids at and around weaning, at least 20% roughage is necessary to stimulate rumen development.

Excessive roughage may limit the intake of Energy and Protein which are critical to optimise growth rates.

Goats being rapidly fattened for sale or slaughter have a very high Energy requirement however a minimum of 15% roughage should be maintained to promote rumen health and allow optimal growth and feed conversion efficiency. Chewing this roughage also stimulates the production of saliva, which buffers the potentially acidic effects of many high Energy concentrates.

Adult dry goats and does in early pregnancy can have 40-70% roughage in their diet. During late pregnancy and lactation, a doe’s diet should contain at least 30% roughage to enable production of high levels of good quality milk.

Green palm fronds in brackets on the wall provide goats with nutrition, exercise and stimulation.

Palm fronds are readily available in Malaysia and make a satisfactory, cost-effective source of roughage for growing and breeding goats.
Minerals

Although six major (macro) minerals and seven minor (trace) minerals are important for goat production, generally only two macro-minerals – calcium (Ca) and sodium (Na) – are needed as specific additives for goat rations in Malaysia.

Phosphorus (P) is also important relative to calcium, but is generally sufficient in the commonly used feeds in Malaysia.

Calcium can be deficient when diets consist mainly of by-products such as copra and palm kernel meals, cassava root (tapioca) by-products, corn and rice by-products and banana meal.

Natural calcium sources are not common amongst feed ingredients although legume forages such as leucaena bushes or leucaena leaf meal can provide useful sources of calcium if fed in sufficient quantities.

The simplest way to provide calcium is by including finely ground agricultural limestone (calcium carbonate) in the ration at 0.4-1.0%.

Do not use “burnt lime”, “slaked lime” or “builders lime” as these are calcium oxide or hydroxide which is an irritant.
During lactation, dietary calcium needs to be increased to ensure sufficient levels are available to suckling kids and in the right proportion to phosphorous for bone and general development. For all goats this is 1.5-2.5 calcium:1.0 phosphorus.

Prior to joining, phosphorus levels must meet minimum requirements to allow proper oestrus cyclic activity in does. For further information on the importance of the phosphate to calcium dietary ratio refer Section 5 – Health.

Sodium is also deficient in most common feed ingredients but can be supplied by the inclusion of between approx 0.2-0.5% of common salt (sodium chloride) in the ration. If unsure of sodium content in ingredients, salt can be offered free choice.

Trace minerals including cobalt, copper, iodine, iron, manganese, selenium and zinc should be supplied via a vitamin/mineral premix included in feed rations.

**Vitamins**

Vitamins A, D and E are likely to be required in shedded goat feeding situations in Malaysia.

For fattening goats these can be provided via a vitamin A, D and E injection upon arrival at the farm.

Breeding does and bucks may need injections on a six monthly basis. Alternatively, vitamins can be supplied via a vitamin/mineral premix added daily to the feed rations.

Sufficient quantities of Vitamin A are normally obtained from fresh forage, green hay and yellow corn. Goats which have been grazing green feed in Australia or Malaysia will probably not require supplementation as Vitamin A is stored in the liver for several months.

Deficiency symptoms include night blindness, eye discharges and ill-thrift.

Vitamin D is supplied in sufficient quantities if goats are kept under sunlight for more than a few hours per day. Shedded goats may require a supplement.

Vitamin E levels in feeds are highly variable and should not be relied on to supply the requirements of high production goats.

Symptoms of deficiency include stillborn kids and animals that suffer from a stiff, stilted gait, lameness or an arched back.
**Crude fat**

Ideally, total dietary levels of Crude Fat (often referred to as Ether Extract in feed analysis) should not exceed 5.0% of dietary Dry Matter as it can interfere with fibre digestion and absorption of nutrients.

With the high oil content of many commonly used tropical ingredients (such as copra and palm kernel meals), it is difficult not to exceed 5.0% and thus more realistic to aim for a maximum Fat level closer to 7.5% (including concentrates, roughages and pasture or shrubs.)

Fats and oils are very high in Energy but are not rumen-fermentable. While analysis of a ration may show sufficient Metabolisable Energy, there might not be enough Fermentable Energy for the microbes to function at maximum efficiency. For high performance rations the larger portion of Metabolisable Energy should come from starches and sugars.

**High Energy rations**

High levels of concentrate feeding, particularly after a high roughage diet, can cause Ruminal Acidosis, nutritional scouring and potentially death.

Ruminal Acidosis is caused by a sudden overload of fermentable carbohydrates causing a build up of lactic acid producing bacteria in the rumen. It usually occurs within three weeks of the diet change as rumen bacteria, protozoa and fungi adapt to the new diet. To avoid this, rations for shedded goats must be carefully managed and slowly introduced over 3-4 weeks.

Additionally, the inclusion of 1-2% sodium bicarbonate in the ration can help to alleviate the condition.

An example of a high Energy ration mix is provided in Table 3 and an example of an introductory ration suitable for conditioning goats to a high Energy ration is shown in Table 4.
## Section 4 - Nutrition

### Ingredients used

<table>
<thead>
<tr>
<th>Ingredients used</th>
<th>Inclusion rate percentage</th>
<th>Metabolisable Energy MJ/day (Dry Matter)</th>
<th>Crude Protein (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn Hominy Meal</td>
<td>10.00</td>
<td>13.6</td>
<td>10.7</td>
</tr>
<tr>
<td>Soy Hull Pellets</td>
<td>12.00</td>
<td>10.6</td>
<td>15.0</td>
</tr>
<tr>
<td>Wheat Bran/Pollard</td>
<td>8.00</td>
<td>11.0</td>
<td>15.0</td>
</tr>
<tr>
<td>Palm Kernel Expeller (PKE)</td>
<td>26.25</td>
<td>10.5</td>
<td>16.5</td>
</tr>
<tr>
<td>Wet Brewer’s Grain</td>
<td>7.00</td>
<td>12.5</td>
<td>25.5</td>
</tr>
<tr>
<td>Palm Fronds (chopped)</td>
<td>14.00</td>
<td>6.0</td>
<td>4.0</td>
</tr>
<tr>
<td>PKC Goat Pellet</td>
<td>18.00</td>
<td>11.6</td>
<td>13.6</td>
</tr>
<tr>
<td>Molasses</td>
<td>4.00</td>
<td>12.5</td>
<td>3.5</td>
</tr>
<tr>
<td>Limestone</td>
<td>0.40</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Salt</td>
<td>0.25</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Vitamin/Mineral Premix</td>
<td>0.10</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>RATION TOTAL</strong></td>
<td><strong>100.00</strong></td>
<td><strong>10.9</strong></td>
<td><strong>13.6</strong></td>
</tr>
</tbody>
</table>

**MEMJ/kg**  **Protein %**

**Table 3: Sample high Energy ration for fattening goats in South-East Asia**

<table>
<thead>
<tr>
<th>Example ingredients</th>
<th>Maximum % High Energy ingredients</th>
<th>Minimum % High Roughage ingredients</th>
<th>Approximate % Proteins and Minerals</th>
<th>Total %</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Days on Feed</strong></td>
<td>8.00</td>
<td>11.0</td>
<td>15.0</td>
<td>100</td>
</tr>
<tr>
<td>1-14</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-28</td>
<td>26.25</td>
<td>10.5</td>
<td>16.5</td>
<td>100</td>
</tr>
<tr>
<td>29 onwards</td>
<td>7.00</td>
<td>12.5</td>
<td>25.5</td>
<td>100</td>
</tr>
</tbody>
</table>

**Table 4: Sample high Energy ration introductory program for goats in South-East Asia**
**Ration formulation**

Reliable laboratory information and consultation with a trained nutritionist regarding the nutritional composition of available feed is the key to formulating cost effective rations in Malaysia.

This data should include Dry Matter %, Ash %, Crude Protein %, Crude Fat %, Crude Fibre %, and Metabolisable Energy (MJ/kg).

**Quality control**

Quality of ration components must be monitored and feed receival protocols be developed including a basic “look, touch and smell” test. If frequently receiving commodities, a quality control sheet should be developed including measurement of the certain criteria with a rejection or discount applicable if quality is not met. Sub-standard feeds should not be fed to young kids, pregnant or lactating does or bucks kept for breeding.

Storage of feeds is vital particularly for high moisture commodities such as chopped green forages, wet brewer’s grains, pineapple pulp or silage as these can ferment or go mouldy very quickly.

A “first in, first out” system should be used. Ask how wet feeds were stored prior to your purchase.

**Conversion from Fresh to Dry Matter**

Goat farmers should be able to readily convert animal intakes and nutrient compositions from a Dry Matter (DM) to a Fresh or AS FED basis. Refer appendix: Understanding Dry Matter.

**Typical feed ingredients**

Goat feeds commonly used in Malaysia and analyses of key nutrients are given in Table 5.

*CAUTION: These lists are intended as a guide only. As nutrient levels can be highly variable, farm managers should independently verify the nutritional composition of available feeds, using a reliable feed analysis laboratory.*
## Section 4 - Nutrition

**Nutrient Analysis (Dry Matter Basis) approximates only**

<table>
<thead>
<tr>
<th>Malaysian ingredients</th>
<th>Ingredient Dry Matter</th>
<th>Metabolisable Energy (MJ/kg)</th>
<th>Crude Protein (%)</th>
<th>Crude Fat (%)</th>
<th>Starch (%)</th>
<th>Neutral Detergent Fibre (%)</th>
<th>Calcium (%)</th>
<th>Phosphorus (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High Energy Ingredients</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn Grain</td>
<td>88.0</td>
<td>14.3</td>
<td>9.3</td>
<td>4.3</td>
<td>65.0</td>
<td>11.7</td>
<td>0.02</td>
<td>0.27</td>
</tr>
<tr>
<td>Corn Hominy Meal</td>
<td>90.0</td>
<td>13.6</td>
<td>10.7</td>
<td>9.8</td>
<td>47.5</td>
<td>21.0</td>
<td>0.02</td>
<td>0.78</td>
</tr>
<tr>
<td>Tapioca Chips (Thailand)</td>
<td>88.0</td>
<td>12.3</td>
<td>3.0</td>
<td>0.9</td>
<td>80.0</td>
<td>11.7</td>
<td>0.14</td>
<td>0.08</td>
</tr>
<tr>
<td>Wheat Bran/Pollard</td>
<td>90.0</td>
<td>11.0</td>
<td>15.0</td>
<td>3.0</td>
<td>23.5</td>
<td>42.5</td>
<td>0.10</td>
<td>1.00</td>
</tr>
<tr>
<td>Soy Hull Pellets</td>
<td>89.0</td>
<td>10.6</td>
<td>15.0</td>
<td>4.0</td>
<td>3.2</td>
<td>60.0</td>
<td>0.68</td>
<td>0.23</td>
</tr>
<tr>
<td>Rice Bran (grade 2)</td>
<td>91.0</td>
<td>11.0</td>
<td>11.1</td>
<td>10.8</td>
<td>23.6</td>
<td>36.9</td>
<td>0.05</td>
<td>1.13</td>
</tr>
<tr>
<td>Corn Gluten Feed</td>
<td>90.0</td>
<td>12.5</td>
<td>16.5</td>
<td>3.8</td>
<td>23.8</td>
<td>32.0</td>
<td>0.03</td>
<td>0.62</td>
</tr>
<tr>
<td>Dried Brewer’s Grain</td>
<td>92.0</td>
<td>12.5</td>
<td>25.5</td>
<td>12.0</td>
<td>2.7</td>
<td>57.6</td>
<td>0.25</td>
<td>0.55</td>
</tr>
<tr>
<td>Wet Brewer’s Grain</td>
<td>21.0</td>
<td>12.5</td>
<td>25.5</td>
<td>12.0</td>
<td>2.7</td>
<td>57.6</td>
<td>0.25</td>
<td>0.55</td>
</tr>
<tr>
<td>Molasses</td>
<td>75.0</td>
<td>12.5</td>
<td>3.5</td>
<td>0.0</td>
<td>0.0</td>
<td>0.2</td>
<td>0.46</td>
<td>0.02</td>
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<tr>
<td><strong>Protein Meals</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soybean Meal (Indian or USA)</td>
<td>91.5</td>
<td>14.8</td>
<td>52.1</td>
<td>1.7</td>
<td>2.3</td>
<td>18.3</td>
<td>0.48</td>
<td>0.55</td>
</tr>
<tr>
<td>Copra Cake</td>
<td>91.0</td>
<td>11.5</td>
<td>22.0</td>
<td>12.5</td>
<td>1.4</td>
<td>53.0</td>
<td>0.10</td>
<td>0.60</td>
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<tr>
<td>Palm Kernel Expeller (PKE)</td>
<td>91.0</td>
<td>10.5</td>
<td>16.5</td>
<td>12.5</td>
<td>1.5</td>
<td>65.0</td>
<td>0.39</td>
<td>0.22</td>
</tr>
<tr>
<td>Palm Kernel Cake (PKC)</td>
<td>88.0</td>
<td>7.8</td>
<td>18.2</td>
<td>3.0</td>
<td>1.0</td>
<td>77.0</td>
<td>0.57</td>
<td>0.25</td>
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<tr>
<td>Leucaena Leaf Meal</td>
<td>92.0</td>
<td>10.9</td>
<td>26.7</td>
<td>2.0</td>
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<td>2.20</td>
<td>0.30</td>
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</tr>
<tr>
<td>Canola Meal (Indian or Pakistan)</td>
<td>90.0</td>
<td>10.4</td>
<td>43.2</td>
<td>1.5</td>
<td>2.2</td>
<td>27.1</td>
<td>0.92</td>
<td>1.15</td>
</tr>
<tr>
<td>Cottonseed Meal</td>
<td>90.0</td>
<td>11.4</td>
<td>47.8</td>
<td>3.8</td>
<td>2.2</td>
<td>29.0</td>
<td>0.20</td>
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</tr>
<tr>
<td>Urea</td>
<td>95.0</td>
<td>0.0</td>
<td>283.0</td>
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<td>0.0</td>
<td>0.0</td>
<td>0.00</td>
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<tr>
<td>Ammonium Sulphate</td>
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<td>0.0</td>
<td>125.0</td>
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<td>0.0</td>
<td>0.0</td>
<td>0.00</td>
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</tr>
</tbody>
</table>

Table 5: Typical feed ingredients for goats in Malaysia
### Nutrient Analysis (Dry Matter Basis) approximates only

<table>
<thead>
<tr>
<th>Malaysian ingredients</th>
<th>Ingredient Dry Matter</th>
<th>Metabolisable Energy (MJ/kg)</th>
<th>Crude Protein (%)</th>
<th>Crude Fat (%)</th>
<th>Starch (%)</th>
<th>Neutral Detergent Fibre (%)</th>
<th>Calcium (%)</th>
<th>Phosphorus (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Roughages</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palm Fronds (chopped)</td>
<td>35.0</td>
<td>6.0</td>
<td>4.0</td>
<td>1.8</td>
<td>1.3</td>
<td>75.0</td>
<td>0.36</td>
<td>0.11</td>
</tr>
<tr>
<td>Napier Grass (mid growth)</td>
<td>18.0</td>
<td>9.5</td>
<td>16.3</td>
<td>3.4</td>
<td>1.1</td>
<td>70.0</td>
<td>0.13</td>
<td>0.30</td>
</tr>
<tr>
<td>Elephant Grass (young)</td>
<td>15.0</td>
<td>9.8</td>
<td>15.2</td>
<td>5.2</td>
<td>1.0</td>
<td>60.0</td>
<td>0.32</td>
<td>0.31</td>
</tr>
<tr>
<td>Sugar Cane Tops</td>
<td>24.0</td>
<td>6.6</td>
<td>6.0</td>
<td>1.9</td>
<td>1.2</td>
<td>68.5</td>
<td>0.30</td>
<td>0.10</td>
</tr>
<tr>
<td>Corn Silage</td>
<td>23.0</td>
<td>8.5</td>
<td>8.5</td>
<td>2.6</td>
<td>15.0</td>
<td>65.0</td>
<td>0.32</td>
<td>0.18</td>
</tr>
<tr>
<td>Leucaena Forage (mature)</td>
<td>30.0</td>
<td>6.6</td>
<td>26.0</td>
<td>3.0</td>
<td>1.5</td>
<td>35.5</td>
<td>0.76</td>
<td>0.22</td>
</tr>
<tr>
<td>Pineapple Waste</td>
<td>11.0</td>
<td>9.0</td>
<td>7.5</td>
<td>1.8</td>
<td>1.7</td>
<td>67.1</td>
<td>0.15</td>
<td>0.20</td>
</tr>
<tr>
<td>Rice Straw</td>
<td>72.0</td>
<td>6.0</td>
<td>6.0</td>
<td>1.4</td>
<td>0.1</td>
<td>71.0</td>
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<td><strong>Minerals/Additives</strong></td>
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</tr>
<tr>
<td>Limestone</td>
<td>98.0</td>
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<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>38.00</td>
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</tr>
<tr>
<td>Dicalcium Phosphate</td>
<td>98.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>21.00</td>
<td>18.00</td>
</tr>
<tr>
<td>Sodium Bicarbonate</td>
<td>95.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Salt</td>
<td>95.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Vitamin/Mineral Premix</td>
<td>98.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>Commercial Feeds</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PKP Cattle Pellet (Penang)</td>
<td>92.0</td>
<td>11.6</td>
<td>13.6</td>
<td>3.0</td>
<td>1.2</td>
<td>44.2</td>
<td>0.72</td>
<td>0.48</td>
</tr>
<tr>
<td>“Microbio Protein”</td>
<td>95.0</td>
<td>10.5</td>
<td>50.0</td>
<td>6.0</td>
<td></td>
<td></td>
<td>0.74</td>
<td>1.05</td>
</tr>
<tr>
<td>Banana Meal</td>
<td>90.0</td>
<td>10.9</td>
<td>8.0</td>
<td>1.1</td>
<td>68.0</td>
<td>17.0</td>
<td>0.13</td>
<td>0.13</td>
</tr>
<tr>
<td>Calf Milk Replacer</td>
<td>95.0</td>
<td>24.0</td>
<td>20.0</td>
<td>0.0</td>
<td>0.90</td>
<td>0.72</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5 (continued): Typical feed ingredients for goats in Malaysia

Section 4 - Nutrition
**Guidelines for fattening goats**

1. Strategic feeding should be considered to supply stock to the market during high demand festival periods.

2. Cost and availability of ingredients must be considered in ration formation.

3. Goats must be encouraged to eat large quantities of a balanced ration.

4. Goats must be started on palatable, high roughage rations with the Energy component gradually increased over the first month on feed.

5. Avoid fluctuations in dietary intakes that cause digestive upsets.

6. Supply fresh feed daily and remove waste and stale feed from troughs.

7. Once adapted to a high Energy ration, ensure feed troughs are empty for no more than one hour per day to maximise feed intake and weight gain.

8. Observe goat pens daily. Move non-eaters and sick goats to sick pens. Treat injured animals with appropriate veterinary drugs or products.

9. Supplement non-eaters and goats with digestive upsets with high quality roughage until normal intakes resume.

**Guidelines for breeding goats**

The principles applying to goats being kept for breeding and growing purposes are similar to those above, except:

1. Basal forage rations with a limited concentrate can be fed at set times and troughs do not need to be always full.

2. Low quality dry forage such as rice straw should be available at all times.

3. Gradually increase the quality and quantity of the ration approaching joining. By commencing three weeks prior to mating, oestrus activity and ovulation rates can be stimulated resulting in increased multiple births.

4. Avoid joining over-fat does and over feeding in early pregnancy as this can lead to kidding problems and possibly “Pregnancy Toxaemia” (refer to Section 5 – Health).
Section 5 - Health

The health issues described in this section are the most common health problems of shedded goats in Malaysia. This section does not cover all possible diseases and specific advice about these and other diseases should be sought from a veterinarian.

**Intestinal Problems**

Gut problems are common in goats and occur for a number of reasons. Early detection and treatment is the key to limiting their affect on growth and performance.

**Causes**

Dietary changes, parasites, infection.

**When likely to occur**

Following diet changes as the goat’s gut adapts; following pasture grazing and the retention of parasites resulting in diarrhoea; animals stressed and bacterially infected following extended travel.

**Signs**

Dietary diarrhoea will usually be mild and disappear without treatment. Goats will appear healthy and retain appetite. Symptoms will be more severe and may result in death in the case of Rumen Acidosis caused by an abrupt increase in the energy content of the diet.

Goats with parasites will weaken and lose weight over an extended period but maintain appetite. They will often be anaemic indicated by very pale gums. Not all animals will necessarily be infected and the parasites should not spread in a shedded environment.

Goats with infectious diarrhoea such as Salmonellosis will be obviously ill, have reduced appetites and will be contagious. The diarrhoea will often have blood in it and have an extremely unpleasant smell. Deaths will be common.

**Diagnosis**

History of diet will assist to confirm dietary change problems. Any animals that have been able to graze pastures in Malaysia will be infected by internal parasites to some extent. Internal parasite infection and other causes of infectious diarrhoea can be confirmed by examining manure samples at a laboratory.

**Treatment**

Electrolytes are recommended for all diarrhoea cases and these may be added to the water supply. Goats with Rumen Acidosis should be treated with antibiotics (Penicillin) and sodium bicarbonate. Animals with internal parasites should be treated with a suitable worm drench.
Infectious diarrhoea should be treated with antibiotics by injection (Trimethoprim and Sulpha drug mixture) and orally. Animals with blood in the diarrhoea should be isolated.

**Prevention**

Make dietary changes as gradual as possible. Treat all animals entering the farm as though they were infected with parasites unless there is certainty of their clean status.

As infectious problems are often associated with stress, actions that minimise stress will reduce the chances and extent of infectious enteritis.

**Non Eaters**

**Cause**

A change of feed stuffs or as a result of other health or behavioural problems such as bullying.

**When likely to occur**

Arrival of new stock and following disease or injury.

**Diagnosis**

Hollow flanks but still drinking, bright and moving around easily.

**Treatment**

Provide a ration which is high (more than 75%) in freshly chopped forage (such as native grass, palm fronds or leucaena) for at least 7 days.

Once eating more normally, gradually reintroduce to the normal farm rations over a period of 2-3 weeks. If the cause is a primary disease problem or bullying this will need to be addressed separately.

**Prevention**

Change rations gradually and identify non eaters early.

**Metabolic Disorders**

**Pregnancy Toxaemia (“twinning disease”)**

**Cause**

A decline in the plane of nutrition during the last six weeks of pregnancy caused by starvation or over-fat condition.

Over-fat animals may not be able to eat enough food to produce adequate levels of nutrition because their enlarged uterus is encroaching on their fat-filled abdomen. In both cases body fat is mobilised in an attempt to generate more energy for the demands of late pregnancy.

**When likely to occur**

During late pregnancy in under nourished, stressed or over fat does and does with twins.

**Signs**

Doe will be depressed and lose appetite. Respiration will become laboured, eyes sunken, they will moan and lie down. Affected does usually die.
**Diagnosis**

Autopsy signs - Swollen yellow liver, jelly-like clear fat in the abdomen, well developed foetus(s).

**Treatment**

Only successful if supplementary energy drenches (propylene glycol) or intravenous injection of glucose are administered very early.

**Prevention**

Prevention through nutrition management.

During the last two months of pregnancy gradually increase the plane of nutrition with increasing percentage of concentrate to allow for a shrinking stomach capacity.

Avoid sudden stress during late pregnancy.

**Ketosis**

(“acetonaemia”)

**Cause**

Occurs in does after kidding when a net loss of Energy follows high levels of lactation and inadequate levels of nutrition.

**When likely to occur**

Four to six weeks after kidding during peak lactation when the doe cannot eat enough to supply her energy needs.

Following stresses such as bad weather or handling that may interfere with nutritional intake and often in association with disease problems such as mastitis or metritis.

**Signs**

Decrease in milk production and appetite, rapid loss of body condition, hard droppings, depression and abdominal pain.

**Diagnosis**

History of lactation, clinical signs and urine test for ketones.

**Treatment**

Direct Energy supplementation as for pregnancy toxaemia and cortisone (dexamethasone) injections. Early treatment is usually effective.

**Prevention**

Ensure does are not excessively fat during pregnancy. Introduce a high quality ration about one month before kidding to allow the rumen to adapt. Follow with a quality roughage diet during peak lactation.

**Milk Fever**

**Cause**

Deficiency of calcium in lactating does.

**When likely to occur**

Heavily lactating does that have recently kidded can lose calcium more quickly than they can absorb it from the feed.

**Signs**

Muscles trembling, then unable to stand, laying down with head turned back, cold extremities.
Diagnosis
Newly kidded doe exhibiting tell tale signs.

Treatment
Injection with calcium borogluconate under the skin.

Prevention
Avoid feeds that are high in calcium for up to a month before kidding. After kidding, give feeds that are high in calcium.

Infectious Diseases

Respiratory Diseases – Pneumonia

Causes
Bacteria, viruses, parasites (lungworm).

When likely to occur
When animals are under stress especially after travel or exposure to wet and windy weather.

Signs
Coughing, difficulty breathing, pus from nose, poor growth. Severe cases can result in death.

Diagnosis
Obvious respiratory problems.

Lung worms are unlikely if the goats have been treated previously or always been on slatted floors but can be identified by sending manure samples to the laboratory for testing.

Treatment
Antibiotics (Oxytetracycline) to treat infection and anti-inflammatory (Flunixil) to reduce stress and inflammation.

Prevention
Reduce stress by providing weather protection. Cheesy gland can cause pneumonia. Prevent by vaccination.

Cheesy Gland

Cause
Bacterial infection.

When likely to occur
Any time. Chronic condition producing abscesses in the lymph nodes.

Contagious through contamination of wounds.

Signs
Abscesses near skin surface varying in size from golf ball to mango. May rupture through the skin discharging infectious pus. If the abscesses move to internal organs severe illness and death will result.

Diagnosis
Appearance and laboratory culture of pus.

Treatment
Lance abscess, drain pus and treat with antiseptic and antibiotics (Penicillin).

Ensure that lancing minimises potential contamination of other goats.
Prevention
Very effective vaccines are available. See section on vaccinations.

*Mastitis*

Cause
Bacterial infection of the udder.

When likely to occur
During lactation, the udder can be infected through poor hygiene (manure and urine) on the floor of the pen or injuries to the udder.

Signs
Swollen, hot, hard udder with watery or flakey milk.

Diagnosis
Identification of tell tale signs.

Treatment
Antibiotic by either injection or specific intra-mammary products directly into the udder via the teat.

Prevention
Maintain clean conditions in pens.

*Tetanus*

Cause
Bacterial infection (Clostridium tetani).

When likely to occur
Following penetrating wounds including splinters, nails, foot trimming and dehorning.

Signs
Stiff limbs and tail, jaws clamped together (lockjaw), saliva drooling from mouth, ears pricked, third eyelid permanently across eye, eventually fully rigid paralysis and death in about two days.

Diagnosis
From signs and wound history if obvious.

Treatment
Penicillin, usually not effective.

Prevention
Very effective vaccines are available. See section on vaccinations.

*Enterotoxaemia* (*“pulpy kidney”*)

Cause
Bacterial infection (Clostridium perfringens).

When likely to occur
Kids in good condition growing quickly on high quality diets.

Signs
Some animals develop diarrhoea and abdominal pain; others may have convulsions and die suddenly. In many cases the goat will be found dead.

Diagnosis
Regular occurrence in kids on high quality rations. Laboratory diagnosis can assist. On post mortem the kidney may appear very soft and "pulpy".
Treatment
Generally there is not time for treatment as death is sudden.

Prevention
Very effective vaccines are available. See section on vaccinations.

External Parasites
Cause
Lice and ticks.

When likely to occur
In sheds only possible if goats previously infected outside.

Signs
Intense itching, goats will rub against the pen resulting in hair loss.

Diagnosis
Careful inspection of the skin will reveal lice and ticks if present.

Treatment
Many highly effective treatments available from injections to pour on products. Ask your local vet what is the best locally available product.

Prevention
Treat all animals on entry to the shed if any doubt about their infection status.

Scabby Mouth ("orf", "contagious ecthyma")

Cause
A virus which is transferred from goat to goat.

When likely to occur
Usually infected as kids when first exposed to the virus. An outbreak in a goat shed where infected goats have been introduced to a population not previously infected can occur and may affect all ages and types of goats.

Diagnosis
Scabby sores on the lips, muzzle and sometimes the skin above the hoof. The sores are apparent for about a week before healing, leaving the goat immune to further infection.

Treatment
Treatment is rarely required as the goat will recover. Topical antibiotics may be applied to the scabs to reduce secondary infection. Access to soft feeds such as cut grass may encourage animals to eat more as infected lips can be painful.

Prevention
Very effective vaccines are available. See section on vaccinations.
**Pink Eye**
(“conjunctivitis”)

**Cause**
Bacteria infecting the eye.

**When likely to occur**
After damage to the eye (dust, palm fronds, etc).

**Signs**
Eye becomes white, progresses to a pink and may rupture. Eye is usually closed and weeping.

**Diagnosis**
Identification of the above signs.

**Treatment**
Specific antibiotic treatments.

**Prevention**
Avoid dusty feed and eye injuries.

**Melioidosis**

**Cause**
Bacterial infection in internal organs, especially lungs, from bacteria found in the soil.

**When likely to occur**
After goats are exposed to soil in wet tropical areas.

Main reason, together with internal parasites, that goats are shedded in tropics.

**Signs**
Varied depending on affected organ. General weakness, depression, weight loss and death.

**Diagnosis**
Post mortem and laboratory testing of goat after exposure to pastures.

**Treatment**
No satisfactory treatment.

**Prevention**
Do not allow goats to graze or come in contact with wet soil in the tropics.

**Important**
This disease can be transmitted to humans with similar results. It is vital that goats never come in contact with wet soil.

**Non infectious diseases**

**Urolithiasis**
(“kidney stones”, “water belly”, “urinary calculi”)

**Cause**
Undissolved minerals in the urine form crystals (stones) which can block the urinary tract.

**When likely to occur**
When diets have an imbalance of the calcium to phosphate ratio. If phosphate (P) is not balanced by calcium (Ca) in the diet then crystals will form in the urine, most commonly in high concentrate diets.
Malaysian feed stuffs such as palm kernel cake (PKC), tapioca, corn and rice bran are high in phosphorus and low in calcium which increases the chances of imbalance. The condition is more important in male goats due to increased chances of a blockage due to a narrower urinary tract.

**Signs**
- Painful, unsuccessful attempts to urinate, dribbling, swollen abdomen.

**Diagnosis**
Clinical signs and response to treatment.

**Treatment**
Acidifying the urine by adding ammonium chloride to the diet will assist in dissolving crystals / stones. Severe cases may require drenching with a solution of this salt to hasten the process.

**Prevention**
Feed diets balanced for Ca:P = 2:1. Add Ca to PKC, copra meal, tapioca, corn and rice by products. Where a balanced diet is not possible, feed ammonium chloride as part of the concentrate diet.

Provide up to 4% salt in the diet to ensure high water consumption. Include Vitamin A in the balanced diet.

**Lameness and Foot Conditions**

**Cause**
Foot injuries or overgrown hooves.

**When likely to occur**
Injuries during transportation. Overgrown hooves result from a good quality diet and a reduction in normal hoof wear due to the non abrasive nature of the wooden slatted floors in sheds.

**Diagnosis**
Simple observation of feet.

**Treatment**
Foot injuries may need first aid while overgrown feet will need trimming.

**Prevention**
Prevent overgrown hooves through the provision of an abrasive surface in the shed. Poorly managed feet can lead to arthritis, reduced feed intake and reduced serving capacity of bucks.
Sudden Death

Cause

Possibilities include pulpy kidney, acute pneumonia, acute mastitis, acute enteritis and poisoning. Usually determined by post mortem examination.

Vaccinations

Several vaccines are available to protect goats, some of which have been combined for ease of administration. The most useful vaccine is 3 in 1, providing protection from cheesy gland, pulpy kidney and tetanus. These often require a follow up injection and annual boosters. Always ensure you read the directions provided with the product carefully.

A locally made Scabby Mouth vaccine is available in Malaysia. By scratching the bare skin on the inside of the leg with a needle covered with the vaccine liquid the goat develops life-long immunity. Ask your veterinarian for more information.

Injections

Injection technique is important to ensure the drug is delivered effectively and that there are no undesirable side effects such as abscesses at injection site.

- Subcutaneous injections (between the skin and the muscle) are best given in the side of the neck where there is plenty of loose skin to lift and it is easy to introduce the needle between the skin and the muscle.

- Intramuscular injections (directly into the muscle mass) can be given into the muscles of the neck or the hind quarter (either the rump or back of the leg).

The provision of rocks for goats to climb and play on in a designated area will assist in wearing goat hooves naturally.

Check with your local vet authority before ordering and using any vaccines. Practical issues such as handling facilities, logistics, costs etc must be considered before making a decision. The disease situation in Peninsular Malaysia and Sabah/Sarawak may vary.

It is important that veterinary supplies be kept in a readily accessible but secure location on-farm. The above shows a lockable cabinet containing veterinary chemicals that can be accessed quickly when required.
Appendices
# Quality control check list and worksheet

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Test/Observation</th>
<th>Good</th>
<th>Average</th>
<th>Bad</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Moisture Dry Matter</strong></td>
<td>Moisture meter, squeeze test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Microwave</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Spoilage</strong></td>
<td>Mould (look at and smell sample)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fermentation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rancidity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Colour</strong></td>
<td>In relation to expected, eg too dark, off-colour</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Contaminants</strong></td>
<td>Soil (score against agreed standards)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Live insects</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Droppings from rats, mice or birds</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Weed seeds, leaves</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stones, sticks, string, plastic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Other comments</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Understanding Dry Matter

**Microwave method**

The nutrients contained in feed are in the dry portion, not in the water content. If all the water is removed by evaporation, the nutrients are still present but now concentrated into a reduced weight of material. The nutrient concentrations in the dry matter are the figures that all feed tables and ration programs use and the goat’s feed intake capacity and nutrient requirements are also expressed on a Dry Matter basis.

On the other hand, feeds are traded on a fresh weight basis and rations are fed to the goat on a fresh weight basis (AS FED).

Therefore it is important to know how to convert from one to another. This is especially important when purchasing moist feeds in order to calculate the true value of the product.

Moisture content is often quoted as a quality factor because it indicates how quickly a feed will deteriorate from mould or bacterial fermentation. Moisture content is not used in nutrition science or ration formulation. If moisture content is given, you should correct to Dry Matter *(refer to Equation 3).*

<table>
<thead>
<tr>
<th>Equations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Equation 1</strong></td>
</tr>
<tr>
<td><strong>Dry Matter %</strong> =</td>
</tr>
</tbody>
</table>
| \[
\frac{100 \times \text{Dry Weight (g)}}{\text{Fresh Weight (g)}}
\] |

*Dry Weight is weight remaining after drying*

| **Equation 2** |
| **Moisture Content %** = |
| \[
\frac{100 \times \text{Water Weight (g)}}{\text{Fresh Weight (g)}}
\] |

*Water Weight is weight lost after drying*

| **Equation 3** |
| **Dry Matter %** = |
| \[
100 - \text{Moisture Content %}
\] |

| **Equation 4** |
| **Dry Matter (DM) kg** = |
| \[
\text{Fresh Weight (kg)} \times \frac{\text{DM} \%}{100}
\] |

| **Equation 5** |
| **Fresh Weight kg** = |
| \[
\frac{100}{\text{DM} \%} \times \text{Dry Matter (DM) (kg)}
\] |
Examples

Converting Fresh Weight (AS FED) to Dry Matter

<table>
<thead>
<tr>
<th>Example 1: Calculating actual Dry Matter intake</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used Equation 4: Dry Matter (DM) kg = Fresh Weight (kg) x ( \frac{DM%}{100} )</td>
</tr>
<tr>
<td>Your goats are eating on average 1.7kg of ration with Dry Matter of 73%. Dry matter (kg) =</td>
</tr>
<tr>
<td>1.7kg AS FED x ( \frac{73}{100} )</td>
</tr>
<tr>
<td>= 1.24kg Dry Matter intake</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Example 2: Calculating the actual quantity of feed purchased and its Dry Matter cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>You purchase 250kg of pineapple cannery waste with Dry Matter of 23%, for $25. Dry Matter (kg) =</td>
</tr>
<tr>
<td>250kg Fresh Weight x ( \frac{23}{100} )</td>
</tr>
<tr>
<td>= 57.5kg Dry Matter</td>
</tr>
<tr>
<td>Cost per unit Dry Matter = $25 per 57.5kg of Dry Matter = $0.43 per kg of Dry Matter</td>
</tr>
<tr>
<td>Short cut: $ per kg Dry Matter = ( \frac{$ per kg fresh Dry Matter %}{100} )</td>
</tr>
<tr>
<td>= 100 x ( \frac{0.10}{23} )</td>
</tr>
<tr>
<td>= $0.43</td>
</tr>
</tbody>
</table>
Converting Dry Matter (kg) to Fresh Weight (AS FED) (kg)

**Used Equation 5:** Fresh Weight (kg) =

\[ \text{Fresh Weight (kg)} = \frac{100}{\text{DM%}} \times \text{Dry Matter (kg)} \]

<table>
<thead>
<tr>
<th>Example 3: Calculating how much feed to purchase</th>
<th>You need to source 105kg Dry Matter of brewers grains, at 24% Dry Matter (to feed 30 goats 250g of Dry Matter per day for 2 weeks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh Weight (kg) =</td>
<td>105kg of Dry Matter \times \frac{100}{24} ]</td>
</tr>
<tr>
<td>= 437.5kg of wet brewers grain</td>
<td></td>
</tr>
</tbody>
</table>

**Example 4:**
Calculating quantity of ingredients to mix in a ration

You need to mix 50kg ration Dry Matter (DM) comprising:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Ration (DM)</th>
<th>Ingredient (DM%)</th>
<th>Equation 5: AS FED (kg)</th>
<th>Ration Mix Ingredient Mix Fresh Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chopped grass</td>
<td>20kg</td>
<td>28%</td>
<td>(= \text{DM (kg)} \times \frac{100}{28} )</td>
<td>71.43kg</td>
</tr>
<tr>
<td>Pineapple waste</td>
<td>15kg</td>
<td>23%</td>
<td>(= \text{DM (kg)} \times \frac{100}{23} )</td>
<td>65.22kg</td>
</tr>
<tr>
<td>PKE meal</td>
<td>13.5kg</td>
<td>89%</td>
<td>(= \text{DM (kg)} \times \frac{100}{89} )</td>
<td>15.17kg</td>
</tr>
<tr>
<td>Mineral Mix</td>
<td>1.5kg</td>
<td>100%</td>
<td>(= \text{DM (kg)} \times \frac{100}{100} )</td>
<td>1.5kg</td>
</tr>
<tr>
<td>Total ration</td>
<td>50kg DM</td>
<td>32.61%</td>
<td><em>(calculated using Equation 1)</em></td>
<td>153.31kg AS FED</td>
</tr>
</tbody>
</table>
## Microwave method for determining Dry Matter worksheet

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Measurement</th>
<th>Record</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weigh a container</td>
<td>Weight of container (C)</td>
<td>C =</td>
</tr>
<tr>
<td>Add sample (approximately 100g) and weigh</td>
<td>Total Weight 1 (T1)</td>
<td>T1 =</td>
</tr>
<tr>
<td></td>
<td><em>(Fresh Weight (FE) = Total – container weight)</em></td>
<td></td>
</tr>
<tr>
<td>Heat for 2 minutes, aerate, weigh again</td>
<td>Total Weight 2 (T2)</td>
<td>T2 =</td>
</tr>
<tr>
<td>Heat for another 2 mins, aerate, weigh again</td>
<td>Total Weight 3 (T3)</td>
<td>T3 =</td>
</tr>
<tr>
<td>Heat for 1 minute, aerate, weigh again</td>
<td>Total Weight 4 (T4)</td>
<td>T4 =</td>
</tr>
<tr>
<td>Repeat process until there is no further weight change.</td>
<td>Final total weight (Tf)</td>
<td>Tf =</td>
</tr>
<tr>
<td>The residual weight of sample material is the Dry Matter, and the weight lost (evaporated) represents the Moisture Content.</td>
<td>Dry Weight (DW) of sample = Tf – Container (C)</td>
<td>DW (g)</td>
</tr>
<tr>
<td></td>
<td>Dry Matter (DM) = 100 x [ \frac{DW}{FW} ]</td>
<td>DM = %</td>
</tr>
</tbody>
</table>

Notes: Microwave times can be varied to suit the sample. Very wet samples require more time initially. Aeration is required to allow water vapours to escape, and to evenly distribute heat flow.

Warning: Sample can burn if heated in microwave for too long. DO NOT LEAVE UNATTENDED. If smoking/burning occurs, use previous weight as final weight.

If allowed by the local authority, bring feed from the ship to the farm to feed the goats for several days. The goats will be used to this feed and this will allow them and their stomachs to gradually adjust to the local feed materials.