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1.0 INTRODUCTION: DO I WANT TO BE A DAIRY PRODUCER?

If you already have cattle, and you wish to begin to begin to raise some of them for producing milk, you should consider the following points before you begin to make the changes which will turn them into dairy animals.

1. Why do you have cattle at present? Is it to make money for your living expenses, or do you have cattle only to slaughter for ceremonial purposes. If you have cattle only for ceremonies and you have to do only a little work to get a few calves from them and you like it that way, perhaps dairying is not for you. Dairying certainly requires that you spend additional money on your cattle, and if you are to produce milk successfully, you will be required to spend considerably more time with them than you do now.

2. Why do you want to have dairy Cows? Do you just want milk for your family to drink, or do you want to produce and sell milk for cash. Or is it simply that you like the idea of something different. If you only want a little milk for home consumption, you can probably get this by getting a dairy type of cow and getting her used to being milked, and feeding her a little better and not doing much else. If you want to produce a surplus of milk for sale however, you must be committed to the idea of more work every day and more planning. And you will have to make some financial investment. If you simply like the idea of doing

something different, or because you think it will be easy to make money by producing milk, dairying may not be for you.

3. Are you prepared and can you afford to spend additional money on your animals? for example buying better heifers or a breeding bull, improving pastures and putting in extra fences. Are you prepared to milk the cows every day and take care in managing the calves. These are some of the things you must do to produce milk successfully. If you can not or are reluctant to do these things, you should consider very carefully whether you still want to be a dairy farmer.

4. Are you prepared to improve your herd by getting rid of animals which are too old for breeding or are otherwise unproductive? Having dairy cows means that you must have some young, vigorous and relatively highly producing cows. If you have a small area of land and too many animals, you will probably have to reduce the number you have so that the ones you keep are the most productive ones. Or you must get some more land. Surplus males and old females should be disposed of to leave grass and water for the more productive animals you wish to convert to milking cattle. Your ordinary beef and the new dairy animals can not successfully run together. If you have a large amount of

land and can put up fences to separate the beef and dairy animals, you should do so. If you cannot, you should probably decide whether you will have beef or dairy cattle. With only a small area of land you probably can not raise both.

5. Are you prepared to build a milking and calf shed for the cows you wish to milk? You

will not be able to produce milk effectively unless you have a shed where the milking can be done, which is weather proof for every-day milking and where new calves can be kept safely.

6. How much land do you have? what condition are your pastures in at the end of the dry season Is it enough for your present cattle all year round, or do the cattle get thin for part of the year and gain weight for the other part of the year. If they get thin for some of the time, there's not enough feed. Dairy cattle will not produce on this much feed. Are the pastures bare or weedy and the cattle thin? If the answer is yes, then you may have too many animals and you must get rid of some, at least until you have established some improved pastures which will support more animals. But if you change your cattle into dairy cows which can produce more milk, you may still not be able to carry the same number of cattle as you do at present,

because dairy cattle require more feed than the ordinary beef cattle you presently have.

7. How old are your present animals? How many males and females do you have? Do you have a large number of old cows and bulls, or a large number of castrated males. If you have old cows, they will not be much use for dairying and should be disposed of The same goes for old or surplus bulls which are also unproductive but also prevent you getting control of the breeding and upgrading your herd will need. If you wish to pursue dairying with all of your animals, you must be prepared to sell the old and unproductive animals, and if you are short of grass, you must keep the number of fattening, castrated males to a minimum.

8. Do you have a continuous supply of water for the cows all year round? Milk is nearly all water and dairy cows need more water than cows which don't produce much milk. So if you have a problem with water now, you must solve that problem so that you have enough for milking cows before getting involved in dairying.

9. Does each of your mature cows produce more or less about one cow each

year? If your in vestment of money and time in dairying is to be rewarded, all of your cows should be as highly productive as possible. This means that a cow should be having a calf and a lactation about once every year. If you are having a problem with the time between calves for each of your cows now, then you must solve that problem before getting into dairying.

10. Are your cattle local types or have they been upgraded in the past by breeding to a dairy type of bull? If they are improved animals, they can be the immediate basis for a dairy herd. However if they are ordinary beef cattle, they must be upgraded either by selling them and replacing them with dairy animals bought locally, or you must use a dairy bull to produce crossbred dairy heifers. Breeding your own heifers will take at least three years before they will produce milk.

11. Are dairy bulls available to you. Can you afford to buy one? Does anybody in your village or nearby have a dairy bull or some high quality dairy cows if you do not. If there are no dairy bulls available locally or you cannot afford to buy one, improving your animals to dairy producers may be too difficult for you.

12. Do you look after the cattle yourself, or does someone else look after

them? Are your helpers reliable and are they prepared to work hard. Successful dairying requires a great deal of time and attention if you are to succeed. It is even more difficult to get hired persons to take the care necessary. If either you or your employees are not willing to work hard and pay attention to the requirements of dairying, you are unlikely to succeed.

13 .Are you and your helpers prepared to keep breeding and production records? Good record keeping, in terms of milk production and reproductive activity, is essential for successful dairying. This means daily record keeping of milk production and regular recording of breeding activity. If you can not do this, your dairying can not be successful.

2.0 TAKING CARE OF DAIRY CATTLE

Dairying requires a different approach to producing beef cattle. Dairy cows can be run as a

herd, but they must be managed as individual animals. This means that

- cows must be observed more closely for their feed and production requirements. A good farmer will check his pastures, fences and each cow and calf every day.

- records of each cow must be kept so that you know if she is breeding properly and producing milk efficiently,

- a simple milking place with a roof, head bail and calf pen must be constructed,

- careful attention must be given to selecting a dairy type bull,

- breeding bulls must be sold or slaughtered before they can mate with their daughters,

- male calves not wanted for breeding must be castrated at an early age,

- the cows must be observed at calving time to prevent calving problems,

- cows which produce milk need much more water than beef cattle.

3.0 CALVING TIME

A cows average pregnancy is 283 days and ranges from 273 to 29T days. Your mating records should allow you to calculate when a cow will calve and observe her closely at around this time.

Most calving will be normal and have no problems. But dairy type cattle, and their calves have large frames. Therefore they may have more difficulties with delivering their calves than village type or beef cattle.

A dairy cow will probably lose at least one calf in her lifetime if she is not well managed. These calves can often be saved by:

1. keeping the calving cow under observation at the time of calving,

2. providing some assistance when it seems that calving is not working and,

3. calling veterinary assistance when you are unable to help.

The cow can be left to calve in the paddock, but it is better to keep her in a small fenced off area so she will not be disturbed by the other cattle, and you can keep an eye on her and provide assistance if this is necessary. The area should be clean and well grassed, where she can comfortably lie down.

3.1. Whether or not to Expect Calving Trouble

As a general rule, if a cow has not produced a calf after 24 hours of beginning to calve, you can assume that she is having trouble. But the following factors influence the chances of her having difficulties, and you should be aware of them:

- Large, milking breeds usually have larger calves, They may have a greater calving difficulty than smaller framed local cows and Brahman derived breeds.

- Young and small heifers have a greater chance of calving difficulty than mature cows. Heifers must be old enough and large enough.

- Mature cows require less attention at calving. Generally, cows which have had at least one calf already, have fewer problems. Although they are usually quick to

deliver their calves, mature cows can also take longer to deliver the calf than heifers, without being in danger.

- Cows kept tethered or in sheds often have more calving difficulties because

their muscles are less active than cows allowed free grazing.

- If the cow has been mated with a bull of a larger breed than she is, she may have a calf which is too large to deliver easily, this is particularly so if she is a first-calf heifer.

3.2. Signs of a Cow which is Calving Soon

You should know from keeping breeding records which cows are due to calve and when they are expected to do so. If you are not sure, follow these tips:

- the abdomen becomes larger in all directions during pregnancy, but a cow with a large abdomen is not necessarily pregnant,

- the udder enlarges and fills one to two weeks before calving, the teats become smooth, firm and larger,

- the udder of heifers begins to develop only at about the fifth month of pregnancy,

- cows which are milking may begin to dry off and may cease milking at about the seventh month of pregnancy,
- foetal movement can sometimes be seen in the left flank from six months on,
- cows which are normally excitable will become calmer,
- The vulva is swollen, and often has streams of mucus coming from it, particularly when the cow gets up after lying down,
- The cow is restless. She gets up and sits down often,
- She will flick her tail often.
- The calves' feet and nose appear at the vulva when she is about to calve.

All of these signs are normal

If the presentation of the calf is normal the cow will show:

- some or all of these signs: The two front feet and the nose of the calf will also be showing, or,

  some or all of these signs and the two back feet of the calf will also be showing.

Figure 1. Normal Presentation for Calving

3.3 What to Do at Calving Time

Most calving takes place normally and without any problems at all, You must remember that: it is better to leave a calving cow alone and undisturbed unless there are obvious signs that she is having trouble. But keep an eye on her from a distance.

- If a cow has been straining for four hours without making progress, an investigation should be made.

- Heifers behave differently to cows. Cows usually calve quickly. Heifers usually take

their time. Once they have started to calve, heifers often delay for an hour and **a** half or so and can be seen getting up, lying down and flicking their tails before getting down to the business of pushing the calf out.

• Signs of danger to a calf being born depend mainly on the size of the heifer (or the cow if she is a small one) and the size of feet of the calf showing (this is a good guide to the size of the calf), and the time which has passed since you first noticed that she was trying to calve.

• A small heifer and two large feet showing means that it maybe better to get veterinary assistance quickly rather than attempting to pull the calf out yourself or waiting to see how it goes.

Contractions in any cow or heifer will always stop after a few hours. A calf cannot be delivered unaided after contractions have stopped. Without contractions, it is then necessary to assist delivery directly and with totally externally applied force.

The general indications of possible calving problems are:

1. restlessness (with the cow getting up and down and turning around) and flicking

the tail,

2. straining for over half an hour without resuks,

3. a small heifer and the appearance of a calf with large feet which hasn't

been delivered after two hours of straining.

4. a calf which is obviously not presenting properly:

- two front feet and no head, or
- a head and one or both feet retained, or
- only one hind foot showing,
- just the tail and buttocks of the calf showing

Figures 2. & 3. Examples of calf position which probably cause difficult delivery

3.4 What to Do in Assisting a Calving Cow

You can assist a cow to calve, **but only provided there are two front feet and a head, or two hind feet presented. With** any other combination of head and feet and, you should call a **veterinarian,** unless you are quite experienced with assisting **in** the delivery of difficult calvings. To assist a cow to calve you need at least:

1. a bucket of clean warm water,

2. a cake of clean bath soap and,

3. two lengths of 1/4" rope two metres long with loops in each end.

4. a rope or halter to tie her head to some fixed point

A cow can be assisted if she is sitting down or standing. Standing cows are easier to

work on. To get started you must:

1. restrain her with a halter or rope, unless she is already lying down and reluctant to move. If you put her in a head bale, make sure if she suddenly sits down that she will not choke.

2. Wash the vulva with soap and water, then wash your hands.

3. If the calf feels dry inside the cow, try to get as much slippery soapy water onto the calf to lubricate it to provide for its easy passage.

4. Attach the ropes to each of the legs above the second joint.

5. Pull downwards. Pull first on one leg and then on the other. Time the pulling to match the contractions. It is better to allow the cow to assist in expelling the calf in time with the contractions, and you must time your pulling with each contraction.

6. If the pulling fails to result in the calf being delivered without much effort on your part, call a veterinarian as quickly as possible.

4.0 AFTER THE CALF IS BORN

For the First Couple of Days:

- remove the placenta so that the cow can not eat it,

- allow the cow to lick the calf dry,

- dip the navel in some Iodine (20%) disinfectant (neat vodka or other strong alcoholic drink will do if there is nothing else),

- assist the calf to suckle the cow if it is having difficulty. You may need to hold the calf up to the cow and guide its head to her udder and in the case of weak calves,

guide the teat into the mouth of the calf. This first meal is very important for the health of the calf and should be taken within five hours of birth.

Figure 4. The calf's first feed of colostrum is essential within five hours of birth

For the first couple of days the calf can stickle the cow as and when it wants. During this time

the colostrum (which is the first milk) is not suitable for human consumption and should not

be sold. But it is very important that within the first 24 hours after being born, that the

calf gets at least three or four feeds of this milk. At the end of the second day however, some provision must be made for removing the calf from the cow and taking care of it, in addition to

getting the milk from the cow for home drinking or for sale. Taking care of the calf so you can

get the milk is a critical part of raising dairy cows.

Managing the young calf

More management and labour is required to care for the calves of cows which are kept to

produce milk for sale or home consumption. For a start, the cow and calf must be separated

within a few days of birth. This is called weaning.

4.1 Weaning

An important activity of dairying. It is not needed when cattle are raised only for meat. Beef calves are allowed to stay with the mother and suckle for as long as they want. But dairy calves are separated from the cow soon after being born. This practice allows most of the milk to be collected and sold, rather than being consumed by the calf.

Also, if the calf is freely fed as much milk as it wants for a long time, it will not have a strong early appetite for dry feed, and its stomach development will be slow and it will not grow well when it has to rely on grazing. So weaning must also involve the feeding of dry feed or roughage to the calf.

Weaning can be done in several ways, but regardless of the weaning system practised, the young calf should be kept warm and dry in a clean, draft-free place.

Below are two weaning systems which may be practised by smallholders

(a) Complete weaning

This is the removal of the calf to a place where the calf and cow can not see or hear

each other. Without good fences and yards to keep the mother and calf separate, it is difficult to do successfully. The advantage of complete weaning is that all of the milk produced by the cow is available for sale, and the cow and the calf soon forget about each other.

BUT,

- complete weaning can be done only by using milk replacers, [special milk powder or cows milk fed from a bucket or teat.

- using powdered milk often causes calf diarrhoea.

- replacers must be imported and paid for, and they must be cheaper than milk otherwise you might as well feed the calf with mother's milk,

- calf feeding using a bucket or bottle to feed milk or milk replacers requires careful attention to good cleanliness and hygiene. If the equipment is dirty the calf may get sick. It is

difficult to do successfully if your hired labour is responsible for calf feeding and they are not interested or do not understand the need for hygiene and correct feeding temperatures.

Therefore complete weaning is recommended only for well developed farms. To give the best results, it is better to adopt the practice of partial weaning.

(b) Partial Weaning

The cow and calf can run together all day in the paddock, or the calf is put into a pen near the cow where it stays all day, but it must not be able to suckle the cow through the bars of the pen. In both cases the calf can only suckle when it is allowed to and must be given feed and water. The number of times it is permitted to suckle depends on whether the cow is milked once or twice each day.

(I) If the cow is milked once each day:

The calf is released to run with the cow each day and is kept in the pen away

from the cow during the night until the morning milking. This has the advantage of the calf being able to develop its stomach by grazing grass during the day as soon as it wishes to graze The disadvantage is that the calf has access to the cow all day and less milk is available for sale than completely isolating the calf and giving it a limited amount of time each day for feeding.

(ii) If the cow is milked both morning and night

The best system when twice a day milking is practised, is to keep the calf penned near the milking bail and allow it to immediately suckle only after the morning and evening milkings have finished. The cow is not fully milked out during milking and enough milk is left by the milker for the calf A small pen is constructed at the front of the headbale and within sight of the cow from which the calf is released to suckle when milking is finished. The calf is returned to the pen until after the next milking, where it is hand fed fresh cut forage, concentrate [e.g. copra meal] and has constant supply of clean water.

Advantages

- more milk is available for sale.

- there is better control over the amount of milk fed to the calf so there is no wastage.

- the calf can be fed concentrates and cut grass in a trough in the pen from the day it is born.

- the progress of the calf can be followed and feeding adjustments can be made if necessary.

Disadvantages

- a separate pen must be constructed.

- sometimes calves receive either too much or too little milk if the right amount of milk is not left unmilked.

- keeping several calves together in the same pen can increase the risk of sickness, and the calves which suck eachother when they are young can enter their first lactation with mastitis.

4.2 Calf feeding

If you are keeping calves penned away from the cows for part of each day, you should remember:

- To allow the first milk (colostrum) to the calf during the first 24 hours. The calf should be allowed to have all that it wants. This is essential if is to remain healthy.

- It is a good idea to keep some colostrum in the freezer. Sometimes a cow will die shortly after giving birth. The stored colostrum, even from another cow, can be thawed and fed to the calf and it is still useful several months after freezing.

- Calves will begin to nibble grass or other forage material from the first day of birth It is important to allow them to do this if they are to develop their stomachs normally for eating grass. If they are penned, they must have grass offered to them all the time. Tie bundles of it to the fence so that they can nibble it. Never put it on the ground for them. Always tie it up or put it in a trough.

- By one month of age, calves should be eating grass and some concentrate

which should both be available to the calf from birth

- Introduce calves to concentrates gradually, and watch how much they are eating Give them a little more each day once they begin to eat it. Any concentrate which the calf does not eat on the day it is given, should be taken away and replaced with fresh feed.

- Calves will feed independently on grass and concentrate from about 2 weeks onwards. Calves can only be completely weaned from milk if you have good quality dry feed I concentrate meal and the calves are eating enough of it before milk is completely withdrawn

- Cut the grass from areas where cattle are not free grazing, to prevent introduction of parasites to the calves. Have a separate fenced area where cattle cannot graze, from which to take the grass for calf feeding.

- The cheapest way to rear a calf is to give it plenty of young, growing, nutritious pasture from birth onwards. Grass and legumes are much cheaper than milk to feed, and milk should be gradually withdrawn, starting when the calves seem to be eating grass and concentrate independently. Calves should be completely weaned off milk

at 8-10 weeks. It is a good idea to increase their interest in grass and concentrates.

Calves must have water. Calves will begin to drink water between their feeds of milk from one to two weeks of age. Lack of water will cause the death of a calf faster than the lack of any other nutrient. By six weeks of age, a calf may be **drinking abut four litres of water per day.** Only clean, fresh drinking water must be given. Water is also especially important for calves if they have diarrhoea or if they go off their milk for any reason.

From calf to breeding age

No matter how small your milking herd, you should aim to replace about one fifth of the milking cows each year. This means that you should try to produce one heifer calf replacement for every five cows you have. If you have a smaller number of cows, it becomes more difficult to maintain this percentage, and you might have to replace at a higher or lower rate from year to year. The cows should be replaced by

heifers which you have raised on the farm, and which you have taken care of and selected as replacements, after they have been weaned. The period from weaning until breeding age is most important in the development of heifers to become dairy cows.

There are several advantages to raising your own replacement heifers:

- by keeping records, you can select heifers from the best performing cows. The cows with the best milking records will probably have the most suitable daughters as replacements,

- you can avoid introducing diseases onto your farm with bought replacements, (always isolate new animals for a week or two to ensure they don't introduce diseases to your own animals)

- if dairying is popular, good replacements may be difficult to buy when you need them,

- you never really know the potential of purchased replacements, because farmers usually only sell those animals they don't want. They

seldom sell their best producing heifers.

If you want to feed your calves better so that they grow well and will mate at an early age, you will have to adapt local feeds to suit your purpose, there is information on formulating diets for dairy cattle elsewhere in this book.

Figure 5. These two calves are six mouths old. The larger received one kg. of concentrate daily for two months in addition to grazing The smaller received grazing only.

5.0 MILKING THE DAIRY COW

Milking should be conducted in a milking place on your farm which has the following essential features:

- a roof (either thatched or sheet iron) to keep out the rain and sun,
- a side wall against which the cows are milked,

- a head bail at one end of the side wall,
- a clean, dry floor, preferably of rough surfaced concrete,
- a small, roofed calf pen close to the head bail in sight of a cow being milked.

Where there is no refrigeration, milking can usually be done only once daily in the morning, after which the milk is processed for immediate sale in the market. Where refrigeration is available to keep the milk overnight to be processed and marketed with the milk collected the following morning, an evening milking can also be done.

The actual activities associated with milking are the same at both times of the day. However regardless of whether the cows are milked once or twice, the milking times each day must be the same.

5.1 Milk Let-down

Milk can only be efficiently taken from a cow when she is relaxed and ready to be milked. This is known as 'milk let-down". Unless this state has been achieved, the

milk will be difficult to extract and not all of the milk she has produced will be available.

Nervous cows which are difficult to get into the bail or which won't settle down for easy milking will not be suitable as milking cows. These cows should be sold and replaced with cows which have a quiet and relaxed temperament.

Milk let-down can be achieved by:

- establishing a milking routine which does not change from day to day,
- not allowing strangers to come to the milking bail during milking,
- ensuring that the cow is not frightened of the bail or the milking process. (She should not be beaten or roughly handled during milking),
- making sure there are no barking dogs or shouting during milking time,

- letting the cow see her calf during milking,

- feeding some or all of the concentrate ration while milking is going on. You could feed her one or two kg. of copra cake each day, or give her green Leticaena or improved pasture to eat while she is bailed-up,

- washing the udder vigorously and waiting for a couple of minutes before beginning to milk,

- talking quietly before and during milking and being gentle and firm in handling the cow at all times.

5.2 Udder preparation, Washing and Milking

When the cow is in the head-bail and is eating her feed ration, you can begin milking. Use a clean bucket which has been washed and sterilised with boiling water.

Follow this sequence:

1. Lock the cow into the head bail,

2. Give the green feed or concentrate for her to eat,

3. Make sure she can see the calf,

4. Wash your hands with soap and water,

5. Wash the udder and each teat vigorously with soap and water and dry them with a **clean** cloth,

6. Direct the first two squirts of milk outside the milking bucket. This milk has the most bacteria in it and should be discarded. Direct the squirts onto a flat surface so that any clots which are present and which indicate mastitis can be seen,

7. Milk the cow by ringing the base of the teat with the thumb and forefinger and using the other three fingers of the same hand to force the milk down and out of the teat. Leave enough milk in the udder for the calf and release the calf for feeding when the milking has been completed. After milking or suckling, the teats should be dipped in a teat dip if available.

The act of vigorous udder washing stimulates milk letdown. But cleanliness in

washing is very important. If the udder and teats are clean but you can not make sure that the water and cloth are also clean, it may be better that you don't wash the udder at all.

5.3 Boiling and Storing the Milk

The milk should be boiled for two reasons.

1. There are bacteria in the milk which can cause the milk to spoil too quickly if they are not destroyed. Boiling quickly kills these bacteria and allows the milk to be held for longer periods without it becoming spoiled.

2. If the cow has diseases such as BRUCELLOSIS or TUBERCULOSIS, the milk can transmit these diseases to humans unless they are destroyed by boiling. Cows also have mastitis sometimes. This is an infection of the udder caused by bacteria which also can make people sick if they drink unboiled milk.

The milk should be brought to the boil on a fire which is not too hot so that it does not bum the milk and it Should be cooled as quickly as possible after reaching the boil. After it is poured into the containers for selling (clean coke or beer bottles are

suitable) these should be stoppered and kept refrigerated until sold. The milk containers should be clean and sterilised with boiling water before they are filled, using a disinfectant similar for use in sterilising baby bottles.

6.0 BREEDING THE DAIRY COW

Raising cattle for milk production requires close attention to breeding them so that they produce the most milk possible. This will require some planning, close observation and recording of matings and regular recording of the daily milk production of all of the cows in the herd. A suitable recording sheet for recording the reproductive activity of cattle is included in this publication.

Heifers of the small, local cattle breed should be able to be mated at about 200 kg. and calve at about 350 kg.. Heavier breeds such as Friesians, should first join at about 270 kg. and calve when they weigh 450 kg.

There are four important considerations in breeding for milk production.

- Selecting the best cows
- Selecting the best bull

Calf castration and selecting the best replacement bulls and heifers.

- Achieving the best breeding efficiency.

6.1 Selecting the Cow

All cows can produce some milk. This is usually too little to be worth collecting for sale, although it may be enough for family consumption. There are some dairy bred cows and cross bred dairy cows (for instance Friesian and Shorthorn breeds) to be found in smallholder beef herds, this are often the descendants of cattle introduced by church missions for their own dairy herds. These can produce more milk than average cattle. They should be selected as the nucleus for starting a dairy herd. If you have this cattle type already, you can either begin to produce milk from them by feeding them better and using them as the beginning of a dairy herd and keeping them until they are replaced by better milk producing heifers or cows. Then these older, starting animals should be sold. There is a classical description of the triangle-

shaped dairy cow which can be used for selection if there are enough dairy heifers around for you to choose. The best heifers and cows for you to start with are those which are quiet in temperament and which have some evidence of dairy blood. If there are none of these, start with quiet local animals with a history of successful breeding, and use a dairy bull over them to produce upgraded offspring.

Figure 6. This is a good type of dairy cow. Note the triangular shape and straight topline of the body, the small, refined head, large udder and milk veins and well spaced teats.

Thus the long term plan should be to replace the original cows with heifers better bred for milk production. Such heifers can be produced from these cows by breeding them to a good, dairy type bull.

To start a dairy herd, the first cows should have these characteristics:

- be of obvious dairy stock i.e. crossbreeds,

- preferably already having calved and therefore demonstrating that they can produce

  calves

- have a good udder and teats

- have a quiet and handleable temperament

- be as close as possible in shape and appearance to the cow in the photograph above.

6.2 Selecting the Bull

The bulls which are generally available on most small farms are unlikely to be useful for upgrading your present cows for dairy production. The safest and most efficient way to obtain a breeding bull is to sell (or castrate) all of the existing bulls on your farm, and replace them with a good dairy type bull from a respected private, school, church or government breeding farm, If you can not get a pure-bred, you should use one which has at least half dairy blood. In this way you can be assured that his

daughters will be superior in milk production to any animals that you already have, or that can be fathered by any other bulls in your neighbourhood.

You should be able to produce two calves fathered by this bull from any of your mature cows before he is sold, when he should be sold or traded to another farmer after three years to prevent him mating his own daughters. Keeping him longer so that he sires offspring from his daughters may result in those offspring having defects which make them unhealthy or unsuitable for production. if you have a choice of bull breed from the farms, it would be better to alternate the breed each time you buy a new bull, because same-breed bulls from the small herds on the farms in Island countries may be too closely related for you to buy unrelated bulls of the same breed every time.

Besides increasing the milk production characteristics of their daughters, most dairy type bulls will also throw excellent beef type calves. In addition to gaining the advantage of milk production from the daughters, a dairy bull will also increase the carcass value of the cattle you sell for beef.

In selecting and using a dairy breeding bull, you should:

- select a good bull from a known source (a government breeding farm),
- make sure he is sound, not lame and can serve properly,
- castrate all other bulls you have,
- prevent outside bulls from coming onto your farm and mating with your cows,
- do not allow the bull to mate with his daughters and replace him after about three years,
- select a replacement bull of a different breed [if available],

6.3 Organising the Mating

You can num the bull with the cows and heifers all year round. This will simplify' your management, **BUT:**

- your cows will produce calves all year round and some will calve during the season when the feed is of poor quality and so will probably not milk well without being fed concentrates, and,

- you will probably not know when each cow was mated, so you will not know when she will calve, nor will you know whether she is pregnant or not until she is almost ready to calve. This means that if there is something wrong with her (or the bull) you might not know until almost a year later,

If you are on the farm all the time or you have good helpers who are observant and interested, it is better to keep the bull confined in a small bull paddock, and detect the cows which are ready to be mated by observing the cows and heifers every day to see if they show signs of oestrus. Cows which are seen to be in oestrus can then be taken to the bull and the mating observed and recorded. The advantages of this breeding system are:

- you can take good care of the bull and make sure he doesn't become injured in the field. He is also quieter and much more easy to manage,

- you will know if a cow is showing breeding activity and you know the breeding dates if she is joined. From this you can predict her calving date, thus,

- you can keep accurate records,

- you can anticipate her next mating time and be ready to join her again if she does not conceive the first time,

- you can quickly tell if you have a problem in the herd if cows continually return to the bull for several months without becoming pregnant,

- you can quickly identify cows or heifers which have reproductive problems

The disadvantage of this system is:

- you need a separate pen for the bull

- you must observe the cows and heifers every day

6.4 Signs of Oestrus

If your cattle are quiet and easy to handle (and all dairy cows and bulls on small farms should be), you can take the cow to the bull and leave her loose in the bull paddock, or you can tie her up to a tree with a rope or halter, and lead the bull to her and allow him to mount. You will know she is ready to be mated when she shows:

- bellowing and perhaps walking up and down a fence line,
- streams of clear mucus coming from the vulva,
- mounting or mounted by other cows,
- if she is running with other cows, her tail may be slightly raised and the hair on the top of the base of the tail may be roughened and standing up,
- if she is milking, her milk production may suddenly fall a little.

Heifers may not show these oestrus signs as strongly as cows. So it is preferable to keep heifers and cows separate, and introduce the bull to the heifer paddock every day after the time when you think they are old and big enough to mate. You should then record any matings that occur. Often if the heifers are old and big enough to mate but for some reason are not showing signs of oestrus, the presence or sight of

a bull will cause them to come into oestrus a few days later.

So keeping the heifers within sight of the bull can be useful, provided your fences are good.

Keeping heifers and cows separate until the heifers enter the milking herd is an important principle, as mature cows will dominate the younger ones, often leading to a loss of weight and delayed breeding activity. Join heifers to the main herd of mature cows only after they have calved.

Oestrus occurs every 18-21 days and lasts for about 18 hours. A cow or heifer will continue to come into oestrus every 18-21 days until she is successfully mated and becomes pregnant. If you see a cow in oestrus in the morning, it is best to have her mated to the bull at that time, and again in the afternoon of the same day. Once a cow becomes pregnant she will not usually come again into oestrus until after she has calved. A very small percentage of heifers will come into oestrus and accept the bull even though they are already pregnant, but this characteristic is not particularly important, particularly if you keep good records.

7.0 SELECTING BREEDERS

7.1 Selecting a Breeding Bull

To achieve improvement in milking performance of the offspring of your cows, It is important to have control over which bull will mate with the cows.

In herds of milking cows where hand mating is practised, where the bull is brought to the cow for mating or the cow is brought to the bull, a mature bull of about four to five years of age can mate with forty to fifty females. In small herds of (say) about ten milking cows, it is better to buy replacement breeding bulls from a reputable source such as the government farms, and make sure that the bull is not related to the cows on the farm. If small farms close together in the same area are not each able to buy a good breeding bull or they each have too few cows to justify a bull each, they could consider buying a bull between them and sharing the services and the initial cost. But unless the farmers co-operate well, this arrangement can lead to

problems if some farmers don't take enough care of the bull when it is their turn to look after it.

If your cows are the small local type, you must be careful to select a bull, preferably a crossbred between the local and improved breeds, which is not too large for the cows, and which has a greater probability of siring small calves which will not cause problems at calving time.

Only if good bulls are not available from a breeding farm should consideration be given to breeding a replacement breeding bull from within the small herd itself.

Swapping unrelated bull calves with other farmers, can be a good source of a replacement bull when they are scarce.

7.2 Selecting the best Replacement Heifers

If you have several (say eight or ten) replacement heifers to choose from, the heifers which are finally chosen should be selected according to these criteria:

- body soundness including suitability of udder and teats

- a quiet temperament

- the milking production of the darn [mother] - you select replacements from the best producing cows

- the source of the sire [father](i.e. whether a local bull or a breeding-farm-bred bull)

- the speed with which the heifer reaches mating age. Select those heifers which have good production characteristics and which come into earliest mating activity.

Thus heifers with udder or teat defects or which are too excitable to be handled and easily milked, should be culled as slaughter animals automatically. If the remaining heifers have the same improved sire, they should be ranked according to the milk production of their dams, and then selected according to the youngest age of first joining. In this way you will gradually improve the milking performance of your herd over several generations, as well as tending to get rid of physical and temperamental defects. At the same time you will protect the ability of the cows ill the herd to breed efficiently.

8.0 ACHIEVING THE BEST BREEDING EFFICIENCY

It is possible for a cow to produce a calf every year. The time between successful mating and birth of the calf is about nine months. Once the calf is born, it may take one to two months for a cow which is well fed and in good condition to return to breeding activity and accept the bull. A return to oestrus sometimes occurs one month after calving, but breeding activity and a successful joining at two months post calving is quite common. A cow will accept the bull at intervals of about 18 to 21 days until she conceives.

It will take about nine months from the time she is successfully mated until she

delivers a calf.

The longer a cow takes to become pregnant again after having calved, the fewer calves and the less milk she will produce in her lifetime and the less money she will generate through the sale of milk and calves. In general, a local type cow can be first bred at about 21 months of age, she will deliver a calf nine months later, and she will remain productively active until she is about seven or eight years of age.

Some cows will of course live longer and produce more calves than this, but from the age of about seven years onwards they begin to lose reproductive efficiency and the time between their calves becomes longer. Their place in he herd should then be taken by new heifers which produce calves at the faster reproductive rate of young animals.

The table below shows the production of two cows with different reproductive efficiency. Both are assumed to produce about 1,500 litres of milk per year. One is mated efficiently every eleven months whereas the other produces a calf every 14 months. It is clear that the cow which produces a calf every year has a great production advantage over the cow which produces a calf at a longer interval.

The factors which determine whether a cow will breed efficiently are:

- the feeding of a heifer until she reaches breeding age
- the availability of a bull at the time the cow is ready to be bred
- whether a cow is being well fed or not - poorly fed cows do not cycle well,
- the presence of reproductive disease in the herd

A heifer will come into breeding activity when she is heavy enough, not when she is old enough. So if you do not feed the young heifer well when she is under twelve months old she will not grow quickly and will be delayed coming into breeding activity until the right weight is reached. The correct first breeding weight is different for all breeds of cattle, but all heifers must be well enough fed to reach this weight

regardless of breed.

A bull must be available to provide mating services to a cow starting from about four weeks after she has delivered a calf. A failure to join when she first comes into season means the loss of some of her lifetime production. Therefore it is important to have a bull available to join with the cow starting from about three weeks after she has delivered a calf

Some services do not result in conception the first time. Therefore it is also important to observe and have the bull available for joining with the cow commencing every 18 days from the last joining period, even if she was served the last time. When (from records you should keep) you know the date she should come into season again, by adding 18-21 days to the date of her last service, keep the bull available for about four days from that date until she is mated again, or she fails to return to season, indicating that she may already be pregnant.

If a cow is poorly fed after delivering a calf, she is unlikely to come into breeding activity until she again begins to put on weight. She should be well fed, particularly

for the two or three months of the dry period before she calves again, as well as during the first three to four months of her lactation.

Reproductive diseases such as Vibriosis or Trichomoniasis will stop your cows from conceiving for several months, even after they have been mated by the bull several times. If you notice from your breeding records that the cows are repeatedly returning to oestrus after joining, particularly if you notice that some cows are also aborting, you should call the veterinarian to examine the herd for the presence of these diseases.

9.0 IMPORTANT FARM TECHNIQUES AND MANAGEMENT PROCEDURES

9.1 Castration

It is common on farms in the Pacific to have a number of young and mature bulls running with **young and mature females.** This uncontrolled breeding will prevent improvement **in** milking quality and breeding efficiency. The safest way to achieve control of breeding is for all male calves that you don't want for breeding to be

castrated before they get to mating age. For ease and safety of castration, the younger a bull calf is castrated, the better. Therefore castration is done for the following reasons:

- inferior quality animals are prevented from breeding,
- inbreeding is prevented,
- castrated males are more easy to handle than uncastrated males,
- beef from castrated males is preferable to meat from bulls.

Bull calves can be castrated from about one month of age. Provided the calf is young enough, any farmer has the skills to castrate his own bull calves.

There are several methods of castration, but the easiest and least risky if it is performed when the calf is young, is open castration, where the testicles are

removed from the sac through incisions made by a sharp knife or a razor. Points to note are:

- always sterilise the knife by boiling before castrating,
- castrate in the early cool of the morning, so that the calf feels less stress and can be observed for problems during the whole of the day,
- with the assistance of a helper, cast the calf on its side in a non dusty area
- make an incision into the testicle from halfway down the sac and completely to the bottom of the sac, so that the wound can freely drain when the calf is standing after the operation,
- protrude the testicle from the incision, separate it from the surrounding tissue, and using the blade of the knife, and keeping tension on the testicle and starting as high up the cord to the calf's body, scrape the blade up and down over the cord until it separates.
- do not cut the testicle off at the cord or the bleeding will be excessive.

Scraping acts to roughen the separated cord and reduce bleeding.

- repeat for other testicle

If available, rubber rings are a very easy and effective method of castration for use on small calves.

9.2 Dehorning Calves

There are no arguments for having horned cattle:

- Cattle with horns will dominate and bully cattle without horns,
- horn less cattle are easier to handle and are less dangerous,
- hornless cattle do not bruise each other, an important factor in animals to be slaughtered,
- separating a calf from a horned cow is more

difficult and dangerous than from a cow without horns.

When dehorning:

- calves should be dehorned as soon as the horn buds appear,
- it is most easily done when calves are about three months old,
- until you are more experienced, dehorning older animals may require the assistance of a veterinarian or paravet,
- do not dehorn after five months else bleeding is severe and a cavity is made in the head of the calf at the base of the horn,

- do not dehorn if calves are sick or weakened,
- the older the calf, the more stress it suffers from dehorning,
- dehorn in the morning during the cool of the day.

Technique

There are several techniques. The easiest is to use a sharp knife with a blade about six cm. long. With one or two helpers, restrain the calf on the ground. Cut around the base of the horn bud about half a centimetre from the base of the bud itself, and cut out the bud making sure that the half-centimetre ring of skin is also removed with the bud. Repeat for other side.

Figure 7. The dehorning method for young calves

9.3 Cattle Identification

If you only have a few cows and can identify them and all of their offspring by name, there is probably no need to identify your cattle in a more permanent way. However a breeding programme can not be introduced into larger herds unless animals can

be individually numbered..

Figure 8. Ear tags are an effective method for identifying young and adult cattle

The preferred and most practical method at the moment, is the use of colour coded and numbered ear tags. These allow cows of one generation, or the offspring of a single bull, to have tags of the same colour, with individual animals within that colour-coded group identified individually by number

9.4. Training Heifers to the Milking Bail

Heifers which have not been handled or have never been put into the milking bail are usually extremely difficult to handle, particularly when they have just calved and must be milked for the first time.

- Well before the calving day, it is important to train a heifer to be familiar with entering the bail and being handled in the same way as she will be when she is milked. It is also much easier to handle and train a heifer when she is still small, rather than waiting until she has a mind of her own and is too big for one person to handle.

- If she has been trained properly before calving, it is easy to bail her up and begin milking her as soon as you want. Therefore it is important to begin handling a heifer when she is still a calf At that age she should get used to being handled all over and having her udder gently massaged.

- You should first train a heifer in being restrained by tying her up to a tree in the shade for a short while every day from about six months of age. Give her some feed while she is tied and use a soft rope tether. Then handle her and brush your hands all over her, especially in the area of the udder until she becomes used to it.

- When she is about a year old and still not too big, she should be trained to enter the bail head. You should put some concentrate or green feed on its other side of the bail head before encouraging her to get into it. The first time you attempt this, you and another person may need to join hands behind her and gently and quietly push her up into the bail. Close the bail head and allow her to stand there and eat the feed for about ten minutes or so before releasing her. This should be done every day for as long as necessary until she will enter the bail and stand there quietly without having to be forced.

- After she is trained to the bail, always milk her from the same side so that she gets used to being milked from that side.

- teach her to stand correctly for milking and by tying her leg back to expose the udder on the milking side, you can train her to prevent her kicking over the milking bucket.

- If her leg on the milking side is forward you can usually get her to put it back by pushing her away from you on the hip on that side. She will usually change her leg position when this is done. You can use your own foot to push back on her leg at the same time to give her more persuasion.

- With the leg back, use a 112 inch rope securely attached to the post behind her on the wall on the other side, pass it around the milking side leg above the claw. Gently tie the leg back about six to ten inches behind the other and fasten it there with a running hatch so that the rope between the leg and the wall has no slack in it, but can be easily released using the slip-knot

- You may then get her used to having her udder and teats handled by rubbing her flank and massaging her udder. She will object initially, but will

accept it if you are gentle and firm and gradually increase the amount of touching from the first time.

- If you take the time to train her well before she has calved, she will be easy to milk and handle when she is put into the bail for the first time. If you do not do this, milking her in the beginning will be difficult and you will get little milk from her until she gets used to the process of milking.

These principles must be remembered when doing this training:

- the heifer must always be handled quietly and gently so that she is not afraid of entering the bail,

- tie the calf close to the other side of the bail head so that she will enter it willingly and be content when she is there,

- put some feed in front of the bail head so that she can eat when milking is going on,

- stop strangers and dogs from being around the bail at milking time,

- keep to the same milking routine every day and always milk her from the same side.

10.0 DISEASE CONTROL AND PREVENTION

10.1 Foot Lameness

There are several common causes of lameness in cattle. They cause a loss in milk production and body condition because of the pain involved, and also because they prevent the cattle from grazing freely and eating as much as they need. The feet conditions result mostly from bad management, and they can usually be prevented by attention to correct husbandry. Once they have already occurred, these conditions usually require expert attention if they are to be successfully treated

Bruised Soles

Cattle are particularly sensitive to foot lameness when they are raised in pastures with protruding stones and rocky outcrops, or if they are forced to walk along roughly surfaced roads in which small stones protrude from the surface. Rough and uneven surfaces are an

important cause of lameness, because they bruise the sole, particularly in the wet season when the feet of cattle are soft. Bruising therefore occurs to a lesser extent in the dry season when the feet of cattle are harder. The bruised areas often develop into dead and empty pockets under the sole, which become infected. An infected sole requires the animal to be restrained and an expert must use a foot knife to trim away the bottom of the foot over the bruised area and apply a foot dressing which remains until the sole has healed.

Overgrown Feet

Foot overgrowth, where the foot grows long and the toe becomes upwardly curving, results from the foot not being able to wear enough too keep the horn short and correctly shaped. Cattle which are grazing and able to freely walk around on reasonably dry hard ground have no problems with overgrown feet. Cows which are always tethered or penned, or which are kept in wet, soft paddocks have feet which do not wear sufficiently. If overgrown feet are noticed before they are too bad, the problem can be corrected by releasing the cattle or shifting them to better drained, harder ground. The feet can also be corrected by a veterinarian with the right equipment and the knowledge of the correct way to trim the feet. If the problem is not corrected for some time however, the bones and joints in the lower foot

become distorted and the condition can not be changed and the effected animals then become permanently lame.

Figure 9. Overgrown feet

Interdigital Papillomatosis

Under muddy conditions usually, a large, wart-like growth takes root usually between the toes of the hind feet. The growth can become quite large and by causing pain and infection, interferes with walking. The growth is fairly easily removed if the leg of the cow is restrained, but will grow back unless the wound left by the removed growth is treated by a veterinarian, using a bandage pack of Copper Sulphate cream.

Figure 10. Interdigital Papilloma

Footrot

This disease is an infection of the foot. It can be a seasonal disease, occurring mainly during the wet season but it can also occur when the season is very dry.

Sometimes only one cow in the herd will have it. Sometimes many will have the disease at one time. It is first observed in cattle when they develop:

- a lameness in one or more feet
- swelling of the foot or a spreading of the toes and a reddening of the tissues above the hoof,
- the foot abscesses where the nail joins the skin and the discharge smells quite bad
- the cow will have a temperature, loss of appetite and body weight and milk production will fall,

It is caused by wet, muddy conditions and when the ground is stony, causing bruising of the sole of the foot. Therefore it can be prevented by draining areas which remain wet and muddy for long periods, and removing stones from roadways

and pastures where possible.

Treatment requires the cow to be restrained by a veterinarian and the foot thoroughly examined, cleaned and dressed. Antibiotics are usually necessary as part of treatment.

10.2 Calf Diarrhoea (Scours)

- this section draws the attention of the farmer to this problem,
- it shows how to recognise a calf with diarrhoea and call assistance,
- emphasises good management as the main method of prevention.

Under normal beef cattle management, diarrhoea (and pneumonia) is not too common in calves. But if farmers are practising dairying they will have to wean their calves. This changes the system and increases calf stress. Calf diseases then have a greater chance of occurring, therefore management must also improve or calf deaths will occur.

Calf diarrhoea is common in dairy calves which are badly raised. It can have many

contributing causes:

- not enough colostrum,
- poor nutrition generally,
- overfeeding,
- feeding milk at the wrong temperature
- using dirty feeding equipment.
- poor shelter so that the calf becomes cold and wet (also causes pneumonia)

Most calf sickness begins with an upset stomach, and upset stomachs are usually preventable.

Under normal grazing conditions, calf scours should not occur much unless calves are weaned into unsuitable, dirty pens or the pastures are overgrazed and young stock are underfed

Figure 11. The scouring calf. It should be treated quickly

The main types of diarrhoea which can occur are,

1. Nutritional Scours

- caused more by indigestion than by bacteria,
- occurs during the first month of birth,
- the dung is liquid and soft.
- the calf will still eat but it loses weight rapidly and may become dehydrated.

2. White Scours

- often caused by a lack of colostrum and dirty conditions,
- occurs mainly during the first week and only during the first month of life,

- droppings are liquid and white or yellow,
- calf has no appetite and is dull and weak.

3. Blood Scours

- often can sed by dirty conditions where several calves are kept together,
- droppings are liquid, bloodstained and smell badly,
- the calf strains when passing dung.

4. Worm Scours

- caused by **internal parasites,**
  - green, brown or **black scours**
  - rough coat, pot belly, dehydration.

The important points to remember are to:

- ensure good hygiene and a clean environment,
- separate young and adult stock,
- protect calves from stress with good housing and management
- strategic deworming
- clean grass from a protected area
- rotational grazing with calves first and adults following
- observe all stock frequently.

With the exception of worm scours which can be prevented by management and treated with **anthelmintics, calf diarrhoea requires treatment which should** be left to the veterinarian and **paravet.**

10.3 Calf Pneumonia

Pneumonia is an infection of the lungs. It occurs in calves:

- in cold and wet conditions (which is why good calf housing is important),
- where several calves are penned together,

and when there is overcrowding - several calves in a pen which is too small for them.

Calves have pneumonia when:

- they cough,
- there is a discharge from the nose,
- loud and painful breathing, often with diarrhoea,
- poor appetite, sometimes followed by death.

Some pneumonia can not be treated

Prevention is the best cure:

- don't overcrowd calves in a pen,
- keep pens clean,
- protect calves from becoming wet and cold.

10.4 Internal Parasites

Worms may cause animals to become sick or die. The signs of worms depend mainly on

- the type of parasite/s
  - tapeworms cause little problems
  - blood sucking worms cause anaemia and weakness
  - worms which move around can cause coughing and pneumonia,

- the number of parasites an animal has,
- the age and health of the animal itself:
  - young animals are more susceptible
  - **a** few worms in a sick animal can be a problem, the same worms in the same animal which is healthy may be no problem at all

Parasitic infestations can be recognised by e loss of body weight,

- green, brown or black diarrhoea, particularly in calves,
- slow rates of weight gain in young stock,
- obvious sickness, lack of appetite, thinness of the body,
- sometimes death - particularly in young animals if

the worms are untreated

Figure 12. The wormy calf. Note the rough coat and pot belly

These points are important:

- worms are mostly a problem of young stock
- adults (older than two years) are usually resistant to them,
- worms are most important during the several months after a calf is weaned, because at that age it is becoming dependent on grazing, adult cattle are the main source of infection for the younger animals Therefore young and old age groups should be separated

Control and Prevention

Most cattle older than two years have few parasite problems, so farmers should concentrate on

preventing worm problems in calves and other young stock

Parasite prevention in young stock involves

- cutting and carrying pasture grass to preweaning calves,
- grass areas for calves should be fenced from the normal grazing areas of older cattle,
- if possible, use fences to subdivide grazing areas to permit rotational grazing.
- where farms are fenced and electric fences are used, young stock should be weaned onto pasture areas which have been "spelled", i.e. not grazed for say 3 weeks.
- move the young stock every three weeks with adult cattle following ten days behind them,
- use broad-spectrum dewormers. Deworm young stock:
    - first at weaning and,

- on two or three occasions 3-5 weeks apart with the first deworming at the onset of the main rams.

You should get the information on the correct type of anthelmintic to use from the veterinarian or local paravet. **But, any farmer can deworm his own animals** using a coke or long neck beer bottle, provided he/she knows the right dose and method

Deworming Method

- deworming calves requires only a long necked bottle.

- with the dose for the calf in the bottle, and the bottle in the right hand, push the calf up against a wall, (or tree if the calf is small),

- by pushing the fingers of the left hand into the left side of the calf's mouth between its front and back teeth, open its mouth just wide enough to put the neck of the bottle over its tongue and pointing down the throat.

- slowly lift the bottle to pour the dose into the mouth and allowing

time for the calf to swallow.

- lower the head immediately if the calf begins coughing.

- add a little water to the bottle to rinse the remaining medicine and give it to the calf in die same way.

10.5 Mastitis

Mastitis is a disease of the milk gland of the cow. It is the most costly disease of dairy cattle, causing loss of milk production and sometimes causing death. It is mostly caused by a bacterial infection which effects one or more quarters of the udder,

- without good management it can be spread by the process of milking, from one infected cow to all cows in a milking herd,

- places with much manure where cows are allowed to calve, contain many of the bacteria which cause mastitis,

- cows which have been dry for more than 60 days have a greater chance of getting mastitis than those with a shorter dry period,

- the risk of a cow getting mastitis increases as her milk production increases. Therefore good producers get more mastitis.

There are two main ways **a cow can become infected:**

- the udder of calves can be infected soon after birth by calves suckling each other, particularly if they are stickling cows which already have mastitis, or calves can pick up the infection from the environment of a dirty calf pen. Calves which are infected develop into heifers with mastitis from the first day they are milked.

- the infection may be transmitted from an infected cow to an uninfected cow on the hands of the milker.

Depending on the bacteria which causes it and how long the cow has had the disease, mastitis shows up in different ways:

New mastitis infections should be suspected if:

- one or several quarters is hot, hard and painful and the milk from that quarter may be thin and watery,
- a thick, yellow or white clotted discharge comes from the teat when it is milked,
- the milk may contain a few small clots when it is squirted onto the floor or the side of the milking bucket.

Old mastitis infections are suspected when:

- the milk contains a few small clots when it is squirted onto the floor or the side of a bucket, and
- when the udder is felt, it may contain large, hard lumps deep within the tissues.
- sometimes **a** thick, greenish-yellow pus may discharge from holes in the skin

of the udder,

Mastitis can be **treated** if it is detected early enough. Every day the first two streams of milk from each cow in **a** small herd should be directed onto the side of the milking bucket to show **up** the clots of mastitis.

Using an RMT kit Simplifies the detection and treatment of Mastitis

The use of the RMT kit **makes** mastitis identification easier and more reliable, cows with a low level of mastitis can be diagnosed and treated early. By doing this, the cow suffers less, there will be less loss of milk production and treatment will generally be cheaper, because the infection is treated at a less advanced stage.

Use the RMT kit if you suspect mastitis, also use it to test each cow as she is first milked after calving [after colostrum is finished]. Regular RMT testing [say every 2 weeks] will help to mastitis early.

How to detect mastitis with the RMT kit

Always ensure that the paddle is clean and dry when used

1. Squeeze a small amount of milk out of each teat into the corresponding quarter of the paddle. Avoid frothing the milk.

2. Tip surplus milk Out of the paddle leaving only 2m1 milk in each segment [use the 2m1 line as a guide]

3. Press 3 ml CMT-Test liquid into each segment of the paddle. One press of the pump is equal to 3m1. Detergent can also be used, it is a matter of finding the right type and concentration of shop bought detergent.

4. Mix well by gently moving in a circular motion. [Change in consistency indicates an increase in the cell content of the milk = mastitis]

If **mastitis** is **detected** but you **have** never encountered mastitis before, you should call the veterinarian or paravet for the correct antibiotics and advise on treatment. The cow would normally be milked out and treated with antibiotics into the infected quarter for a number of treatments over several days according to the advise given. The milk of the quarters which are under treatment should always be discarded.

If the cow is not treated or the treatment is not effective, the infected tissue is

eventually replaced by dead scar tissue and that part of the udder will no longer produce milk. Quite often, these old cases of mastitis act as a source of infection for other cows in the herd. Cows which are badly infected with old mastitis will often produce very little milk at all and they should be culled. The udders of cows which you may consider buying to add to your herd should always be examined. Those cows with signs of mastitis should be rejected.

Mastitis can **be prevented** by good management which begins with **the** birth of the calf.

- calves should not be permitted to suckle each other's udders, particularly if they are feeding from cows which already have mastitis. The infection is transmitted to the calf and develops in the udder of the calf from the first day the heifer comes into milk.

- calf pens should be kept clean.

- cows known to have mastitis should be milked after all of the other cows, their milk should be tested by squirting into **a separate** cup, not onto the floor as this milk has **a** higher chance of being infective. **Once**

treated, they **should be used** only to suckle foster calves for the **remainder** of that lactation,

- the hands of the milker should be thoroughly washed between finishing milking one cow **and** beginning the milking of the next. This will prevent mastitis being **transmitted** to uninfected cows from mastitis cows which have not yet been **detected.**

11.0 PASTURES FOR DAIRY PRODUCTION

The amount of milk a cow can produce is directly related to the quality and quantity of food which she eats. If quality and or quantity is lacking the cow will respond by producing less milk. In the short term (say less than one week) the cow may mobilise her own body reserves in order to maintain her production of milk. If she is not fed sufficiently over a longer period both daily production and the length of lactation will be reduced, Also the cow will be in a poor (thin) physical state, the likely consequence of this is an extended post-partum anoestrus (the length of time often calving before a cow is able to get in calf). Therefore the cow will have an extended calving interval - it will be a long time until she has her next calf

Income per lactation includes one calf valued at $500.00

[Allowance of $800.00 has been made for the sale of the cow at the end of her productive life

The cows both calve for the first time at two years of age and leave the herd (sold) at seven

years old Input costs have not been included, it is likely that costs will be slightly higher for the well fed cow although many costs will be the same. All other factors, such as breeding, are held constant]

From this it can be seen that it is very much in the farmers interest to ensure that the cow is well fed and cared for. Sample comparisons including costs and benefits for different situations are included later in this publication.

11.1 Areas Suited to Dairy Production

It is possible to farm dairy cattle in any area where beef can be produced, however high, wet less fertile land should be avoided as should be dry and infertile or very rocky land as the greater levels of supplementary feeding needed to maintain

production will have a negative effect on profit. Low altitude moderate to low density coconut plantations (less than 125 20 year old palms per hectare) are ideal for smallholder dairying.

11.2 Choice of Pasture Varieties

Whilst a cut and carry system is possible, most farmers will find that provided they have enough land, a grazing system be it tethered or within a fence is more productive (reef Reynolds S G a 1995). It is most important that dairy cattle be offered well managed pastures consisting of grass and legumes.

As an example, for smallholder dairying in Samoa the most appropriate grass species for most locations and levels of management is batiki grass; *Achaemum uristatium,* there are however some useful alternatives which are described briefly below. It is widely agreed that in selecting the most appropriate pasture variety for improved production, the important factors to consider are.

- **Yield**
- **Palatability**

- **Nutritive value**
- **Ease of propagation**
- **Rapidity of establishment**
- **Ability to compete with weeds Pest and disease resistance**
- **Ability to associate with other pasture species**
- **Adaptability to local soil, climatic conditions, management levels and if under coconuts; shade tolerance and degree of competitiveness with coconut trees.**

Below is an introductory description of some pasture varieties Which are currently used in the

South Pacific for dairy production.

For more information on the characteristics, establishment and management of pasture varieties

consult your local livestock

extensionist or pastures advisor.

Batiki grass *(Ischaemum aristatum)*- see Photo 1.

is easy to establish and grows well in high rainfall areas, it has low drought tolerance. Grows well in moderate shade such as under coconuts. Under good management fair to good animal performance can be obtained, 400 kg beef per hectare/year has been produced in Samoa using a short length rotational grazing regime to maintain pasture quality. Is very competitive -controls weeds well. Usually grown from cuttings.

Signal grass *(Brachiaria brizantha)*- see Photo 2.

grows well in most places that batiki will grow except the higher, wetter and less fertile lands, it is more tolerant of dry conditions than batiki. Signal is slightly less tolerant of shade than

batiki. Given good management signal pastures will produce more milk and or meat than batiki. May be grown from cuttings.

Splenda setaria *(Setaria sphacelata* var. splenda) see Photo 3.

is a newly introduced grass which has shown very good potential for dairy production. Reports from Vanuatu and Fiji indicate that splenda gives the highest milk production of any grazing system. Also the author has seen splenda completely suppressing navua sedge *(Kyllinga polyphylla)* in Fiji, the ability of a pasture plant to compete successfully against weeds is a great advantage. Farmers in all but the drought prone areas, and with good levels of management, who do not have an established improved grass species should consider planting this variety. May be grown from cuttings, or seed.

Guinea grass *(Panicum maximum)*

An erect tussock grass which can spread by rhizomes at the base.

Very widely used forage in the Pacific, often growing voluntarily on roadsides and fallow cropping land. Suitable for grazing and cut and carry. Young guinea foliage has a high level of digestibility [in-vitro digestibility of 68%, 58%, 54% and 50% have been measured in regrowth of 2, 4,6 and 8 weeks], so is well suited to dairy production, However it does require careful management, particularly during dry

periods because its tussock like growth habit is susceptible to overgrazing resuking in weed invasion starting on the bare ground surrounding the plant base.

Can be planted by seed or rooted splits.

Para grass (*Brachiaria mutica*)

A robust creeping perennial which tends to spread by rooting at the nodes. Stems and leaves are very hairy. The infiorescence is a panicle with up to 20 densely seeded racernes.

Widely grazed in the Pacific particularly well suited to wet climates and swampy areas [it can grow in water]. Does not have good dry area performance. Para is reputed to have higher digestibility than its relative signal grass [B decumbetis], but tends to be more difficult to manage as it does not creep as well as signal and is therefore more susceptible to weed invasion.

Can be planted by seed or lower stem cuttings [which have primordial roots]

Elephant or napier grass *(Penisetum purpureum)*

A very tall [upto 7m] deep rooting, erect grass with short rhizomes. The plant is bristly with tough cutty leaves. The inflorescence is a spike like panicle, very little viable seed is formed.

Widely grazed in the Pacific particularly by tethered cattle in non-fenced areas. Has great potential for dairy production as a cut and carry variety, especially the hybrid types which have higher production and digestibility than common types. Potential production is the highest of all grasses, figures of 60 000 kg DM/ha per year have been achieved with intensive management and fertiliser use. Has very good drought tolerance. Planted by stem cuttings with 3 nodes.

11.3 Grasses for Drought Prone Areas

Farmers should consider whether or not the locality in which their farms lie are prone to drought. This is characterised by extended periods without rain which cause plant growth to suffer e.g. wilting, low plant growth rates or plant death. In these cases pasture varieties (grass and legume) which are able to survive and or possibly maintain production in dry periods should be selected.

If you are in a drought prone area, you should plant at least some of your pasture area in drought tolerant varieties

Koronivia grass *(Brachiaria humidicola).*

has better drought tolerance than signal, which it is similar in appearance to but less hairy and tougher foliage with a less erect growth habit.

This grass grows well under moderately shaded conditions i.e. more than 70% light (ref Reynolds S G b 1988) and has good drought tolerance. May be grown from cuttings

Bisset creeping blue grass *(Bothriochloa insculpta* cv Bisset.)

is newly introduced to Western Samoa and shows considerable promise as a high yielding drought tolerant forage, is similar but so far appears higher producing than hatch grass *(Bothriochloa* insculpta cv hatch). May be grown from cuttings.

4. Legumes for Dairy Pastures

The jointvetch *(Aeschynomene americana* cv Glenn, and *Aeschynomene americana*

cv Lee)- see Photo 4.

Glenn is an annual to weak perennial sub-shrub which has proven itself to be a highly productive as well as easily established and managed pasture legume in South Pacific grazing systems.

Lee is a more recently introduced variety which has shown Glenn's strong adaptation to local conditions, in addition; being a perennial Lee does not have to regenerate itself each year by seeding. Consequently, being a lighter seed producer, Lee tends to produce leaf all year rotund whereas Glenn dies off in the dry season. Both jointvetches should be included in dairy pastures. Glenn jointvetch has proven itself to be adapted to a very wide range of soil and rainfall environments, both shaded and unshaded. These forages can combine well with grasses such as batiki and signal. Grown from seed.

Greenleaf desmodium *(Desmodium intortum)*

This is a deep rooted trailing perennial which has been proven (in Samoa) to grow well in all areas except drought prone zones and areas of very low fertility. Sometimes slow to establish, probably due to its small seed size, greenleaf persists

well under rotational grazing systems and has been shown to be one of the best pasture legumes in coconut plantations. It is very tolerant of wet conditions. Grown from seed.

Centro *(Centrosema pubescens)* see Photo 5.

A perennial creeping plant which is vigorous and capable of persisting in grass dominated pastures. Often seeds can be picked from plants found growing on fences. Drought and moderately shade tolerant. Grown from seed.

Hetero *(Desmodium heterophylium)*

A low growing perennial creeper with small ovate trifoliate leaves and pink flowers. This

extremely adaptable legtime is widely occurring in Samoa and other countries. Hetero is planted as a cutting, planting material is often available on the road sides. It may be planted into dungpats in existing pastures or mixed with grass cuttings in new plantings. It grows well under coconuts and mixes well with improved grasses.

Siratro *(Niacroptihum afropurpureum)*- see Photo 6.

now found in many Pacific island countries. This twining perennial is deep rooted, quite easy to establish, combines well with grasses and will grow in a variety of soil types but not heavy clays. Has quite good drought tolerance but does not tolerate very wet conditions, as all the foliage will collapse very quickly with fungal leaf rot *[Rhizoctonia* solani]. Established from seed does not generally require rhizobial inoculation.

Stylos *(Stylosanthes* species)- see Photo 7.

below are notes on 2 stylos which have been grown with success in the Pacific:

> **I. seca stylo *(Stylosanthes scabra)* this is a sub-shrub with small blue-green sticky leaves. It is very tolerant of drought. Whilst it is not amongst the best quality legumes in terms of feed, its persistence and ability to provide reasonable forage when most other plants have ceased to grow due to water stress makes it an excellent choice for areas prone to drought. It will grow on poor acid and sandy soils but does not like water logged conditions. Grown from seed and should be inoculated with specific rhizobia if no stylo has been**

grown in the pasture before.

2. verano stylo *(Stylasanthes hamata)* this is a low growing short lived perennial with many branches. Leaves are trifoliate with narrow pointed leaflets which are bright green and silvery on the underside. Has similar drought tolerance and growing requirements as seca.

Pinto peanut *(Arachis pintoi)*- see Photo 8.

a very strongly creeping stoloniferous perennial which roots at the nodes. Not yet widely grown throughout the Pacific but has a lot of potential due to shade tolerance and ability to combine well with grasses and tolerate heavy grazing. Foliage has very good digestibility

[73%+]

Some problems have been encountered with establishment due to poor seed quality and moculation. Recommended to first establish a small nursery and to transplant rooted stolons.

Glycine *(Neonotonia wightii)*

A perennial twining herb with a woody crown and pinnately trifoliate leaves bow on slender stems. The deep tap root gives good drought resistance. Best suited to areas with rainfall of 1000 to 2000 mm., does best on well drained soils. Varieties Tinaroo and Cooper prefer better soils whilst var. Malawi will tolerate acid and low fertility soils.

Glycine is very strongly growing and combines well with tall grasses, will smother weeds and fences if ungrazed.

Planted by seed treated with cow pea strain moculant.

Sensitive plant (Mimosa pudica)- see Photo 9.

This low branching, creeping, thomy perennial is widespread. Sometimes considered a weed, sensitive has a useful role as a pasture legume providing it does not dominate a pasture due to overgrazing. It is widely adapted to a range of conditions including under coconuts. Tolerates very heavy grazing. Not recommended for planting.

11.5 Shrub Legumes

Shrub legumes have great promise in improving the quality of diet for dairy cattle. The ability to produce large amounts of digestible, high protein feed at low cost makes them an important component of the dairy feeding programme. Shrub legumes may be grazed in-situ; planted in rows (plant density of 2 000-4 000 plants per hectare) or in a high density feed bank (approx. 10 000 plants per hectare, or 2 000 6 000 pants/ha plus elephant grass). Many shrub legumes are well suited to cut and carry, this includes locally occurring varieties such as *Albizia chinensis.*

Calliandra *(Calliandra calothyrsus)* see Photo 10.

A high yielding shrub legume capable of growing to around 7 metres. This tree legume has been shown to persist well in rotationally grazed pastures, provided that it is cut to about 1 metre after grazing. Plant persistence can be adversely affected by damage by stock especially when grazed by large and boisterous animal such as bulls. Well suited to cut and carry systems. The foliage has quite high tannin levels, therefore cattle need to be "forced" [given no choice of feed] to eat it initially however after the first grazing, they will eat it happily. Calliandra is tolerant of high rainfall (5000 mm pa) and low fertility but is not drought tolerant. Usually

planted as seedlings.

Leucaena *(Leucaena leucocephala)*- see Photo 11.

There are two varieties of this shrub legume species proven for Western Samoan pastures:

Cunningham leucaena and leucaena K636.

Whilst these varieties are considerably lower yielding than Calliandra, they are extremely persistent once established and offer higher quality forage. Leucaenas are proven to grow in rainfalls of around 3500 mm pa, however they probably have their strongest role to play in the drought prone areas due to their ability to thrive in dry conditions. *Leucaena leucocephala* can be heavily damaged by insect [psyllid] attack, leucaena hybrids such as KX2 have been developed which have a greater resistance to psyllids and are potentially higher producing. KX2 and KX3 are currently being evaluated in Samoa [1998]. Usually planted as seedlings which have been raised in a nursery.

12. DAIRY FARM MANAGEMENT

12.1 Identifying Problems and Constraints

This manual does not attempt to cover every factor of issue which affects farm performance rather we will cover a broad outline of the factors affecting decision making on the farm and examine in some detail some of the major constraints to production and methods of minimising these constraints.

The first question one must ask is: what is wrong with things as they are?

There is only a problem if the farmer wants or needs to improve:

e.g.

-to produce more

-make more money

-get a better return from labour

-comply with a law or local convention

-other personal reason

• If the farmer wishes to improve production, he/she needs to consider firstly how the farm is operating at present:

-what and how much of each product is the farm producing?

-what are the daily activities?

-what amount of land, money and time is involved in producing each product?

-which products are the most profitable?

-how does production of different products inter-relate?

• What are the main factors stopping the farmer from increasing performance? [constraints]

-It may be that one crop uses up all the available supply of some limited resource, such as working capital, water or labour. This crop may be very

profitable but if it means that other resources [such as land] can not be fully farmed, say because of a labour shortage, then the farmer may riot be gaining the best benefit from the total farm system.

• Through this process of farm assessment the farmer is well placed to make the best decisions regarding changes on the farm,

The constraints that we will discuss are those which can most often be minimised through traming in practical farm work techniques [and appropriate technology, farm management and the adoption of improved animal care and management as well as improved forage species, and supplements.

Given training, the farmer can decide how and when to adjust the types and balance of crops, pastures and livestock in the farm system, in order to plan and carry out a programme of development.

More appropriate types of plants and animals can be raised which are not affected by the constraints to production.

12.2 Pasture Management for Dairy Farmers

Good pasture management is one of the most important aspects of successful dairy production. Once an improved grass-legume pasture is established it can remain productive and weed free, providing large amounts of good quality feed for dairy cows, bulls, and young stock for many years. This will occur so long as the person managing the farm follows some simple rules, as follows:

12.2.1 Stocking rate [SR]

Maintaining the appropriate stocking rate is perhaps the most important rule of pasture management. The right stocking rate will vary from farm to farm, depending on;

- **soil fertility**
- **annual rainfall and its distribution**
- **whether the pasture is shaded or unshaded**
- **pasture variety (improved Vs unimproved)**

- use of fertiliser

- pests and diseases of the pasture

Stocking rate is generally expressed in terms of animal units per hectare. One animal unit is equivalent to one cattle beast weighing 450 kg. Thus an animal of with a liveweight of 600 kg = 1.33 au, whilst one weighing 225 kg = 0.5 au. This is based on the assumption that the daily feed requirement of cattle is a constant percentage of their body weight: 3% of body weight in good quality pasture dry matter. This is not completely accurate as the percentage will vary for different ages of stock and quality of feed and level of production, never the less it is a very valuable yardstick which will allow a farmer or adviser to match demand and supply of feed in such a way as to achieve high desired sustainable production of milk and or beef.

As an example, the average the carrying capacity (SR) of improved (batiki + legume) pastures is;

Open Pastures -2.5 au/ha

Under coconuts -2.0 au/ha

These stocking rates represent the balance at which animal and plant [pasture] production can be sustained.

Assessing the appropriate level of stocking

The farm manager should monitor the feed supply (pasta re) availability of the farm at least twice a week. The purpose of this is to match feed supply (pasture growth) with the needs of the animals. Small fluctuations in feed supply due to short periods without rain can normally be accounted for by a little supplementary feeding with elephant grass or similar. If on the other hand pasture availability is too little or too much, changes in the way the farm is run should be made as soon as possible, as even though it may not be observable, production will be suffering.

If rotational grazing is used, the pasture should be about 30 cm high (mid-calf) when the cows start grazing and about 15 cm high (just above the ankle) when cows are removed. Under set stocking pasture should be of even height, about 15 - 20 cm.

Figure 13 and 14.

PASTURE AT MID CALF HEIGHT PASTURE AT ABOVE ANKLE

HEIGHT

Other indicators of incorrect SR are;

1 - more weeds observed in the pasture,- SR is too high.

2 - pasture height uneven , with tall clumps of grass, - SR is too low

What to do if SR is not appropriate

Too High?

This can easily happen, because the area grazed is limited but animals tend to grow and multiply.

Action to restore a good feed supply Should be taken urgently as if a milking cow 5 feeding is reduced for any length of time it is very difficult to make up losses in production later. The farmer has two alternatives,

1 - Increase the feed supply by;

a/ using more fertiliser, which should be spread evenly over the whole grazing area. Price and availability varies from country to country, for the most appropriate fertiliser, consult your local extension officer and Agricultural supplier. should be spread evenly over the whole grazing area. This should be repeated every six months. The stocking of the farm should probably not be raised higher than its current level.

b/ practising supplementary feeding or zero grazing, cut and carry grass and legumes are suitable in this case. To allow the pastures to grow back again, as much area as possible should be closed from grazing for about 3 weeks which given rain should allow it time to recover, after this it should be stocked at the appropriate stocking level by the milking cows. The balance of the stock should be held on the rest of the farm, as small an area as possible leaving as much as possible for milk production. Higher than normal levels of supplementary feeding to the dairy cows is also necessary.

2 - Decrease the stocking rate, either by

a/ increasing the total grazed area, i.e. fencing more land or tethering some cattle outside the fenced area, such as roadsides

and cropping land which have been harvested. This will effectively decrease the average stocking rate per hectare.

b/ sell some animals. This is a practice that all farmers must consider, particularly those with only small farms. To ensure the best animal health, production and profits from the farm animal numbers must be limited. This also adds to the farmers income through the sale of unneeded, old and unproductive animals.

The Farmer needs to answer these questions

1. What is the main purpose of the farm?

2. Which cattle are necessary to obtain the objective.

Sample Answers:

1. The main purpose in this example is to earn income from milk sales.

2. The necessary animals are:

heifer calves

yearling heifers

2 yr heifers

milking cows

bulls - (1 for every 30 cows)

Below is an example of an overstocked situation and how a farm manager can assess the ideal stocking rate and go about adjusting the herd to Suit.

12.2.2 Calculation of Farm Carrying Capacity

A small holder farm of 12 ha, of which:

9 ha pasture tinder 40 year old coconuts

3 ha open pasture

12ha 9@ 2au/ha = 18

3@ 2.5 au/ha = 7.5

25.5 animal units total capacity

Table 3 - Stock on the farm at the start of the exercise

	No. Animal	LW	Au/Animal	Au/Class of Animal
Heifer	4	100	0.22	0.88
Bull	4	100	0.22	0.88
Heifer	4	250	0.56	2.24
Steers & bulls	3	250	0.56	1.67
Heifer	4	450	1	4.0
Steers & bulls	3	450	1	3.0

Milking cows	10	500	1.11	11.1
MA steers	5	500	1.11	5.55
MA bulls	2	700	1.56	3.12
Cows	3	450	1	3
TOTAL	42 [Animals]			35.44 [au]

N.B. MA = Mixed Age

The correct carrying capacity is estimated at 25.5 au therefore the farm is over stocked by 9.9 4 au(35.44-25.5 9.94).

The farmer should therefore consider the best way to reduce the number of animal units carried on the grazed area. (for simplicity we will not include using fertiliser in this example). The 2 main factors mentioned above should be applied in choosing which cattle should go (sold, tethered outside the fence, yard fed or transferred to another farm).

Table 4 - Farm herd structure

Class of Animal		No. Animal	Au/Class
Calves	Heifer	5	1.1
	Bull	5	1.1
1 yr	Heifer	4	2.24
	Bull	0	
2 yr	Heifer	4	4.00
	Bull	0	
Milking	cows	13	14.43
Herd	Bulls	1	1.56
1 yr	bull	1	0.56
Old	Cows	0	
	TOTAL		24.99

So a farm with about 25.5 au could be structured as follows:

This maximises the number of productive animals [milking cows] whilst balancing the stocking rate with the carrying capacity.

Actions taken to make the change were

1. All old non productive cows sold

2. Sale of excess bulls

3. Sale of all bull calves as weaners

4. Sale of one weaner heifer (keep the best)

5. Sale of 3 yrs steers

Sale of 3 2 yrs steers

Sale of 5 mixed age steers

The following increases are made

1. purchase of a 1 year bull (to avoid inbreeding)

2. Increase in milking cows

3. Increase in calves

Table 5. Changes made in restructuring the herd

	Before	After	Diff.	Diff. [au]
H	4	5	+1	+0.22
B	4	5	+1	+0.22
H	4	4	0	0
B	3	0	-3	-1.68

H	4	4	0	0
B	3	0	-3	-3
Cows	10	13	+3	+3.33
Steers	5	0	-5	-5.55
Bulls	2	1	-1	-1.56
Cows	3	0	-3	-3
Bulls	0	1	+1	+0.56

Net reduction off 10.46 au. (4.33 - 14.79)

By restructuring the herd, the farmer has simplified the operation and been able to increase the number of productive animals i.e. cows by 3.

This will increase the milk production. Production increases as a result of better feeding would be expected to be in the order of:

1. Decrease in calving interval from 540 to 410 days would increase annual calving percentage.

2. Milk production per lactation would increase by approx. 100% or more per cow.

A Note on Pasture Management

Good pasture management is more important in dairy farming than in beef production. This is because

1. Expenses (and returns) tend to be higher, therefore all aspects of management need to be good to combine to a high level of production.

2. Whilst beef animals are to some extent able to rely on compensatory growth to even out low production of beef caused by periods of poor or low quantity feeding, dairy cows cannot so easily recoup lost milk production, after poor feeding.

Good pasture management is: producing constant large quantities of good quality

forage to be converted into useful products by grazing cattle year after year.

12.2.3 Grass-Legume Balance

The pasture should ideally contain at least 20% legume (leaf) on a DM (dry matter) basis High legume content increases the protein content and per cow intake of the pasture.

High legume content can be encouraged by:

1. planting recommended pasture legumes

2. good management of newly planted pastures/legumes encouraging their spread in the pasture, during the first 12 months especially.

3. strategic heavy grazing in the early wet season to encourage germination of aruinal legumes such as Glenn jointvetch,

4. the use of phosphate fertilisers.

4. Pasture Growth Stage

The grass tends to be the dominant plant in an improved pasture. Whilst tropical grasses are highly effective at photosynthesis and thus compete well for space and light they tend to be very low in crude protein. Tropical grasses tend to have decreasing levels of protein and as they mature (leaf age). The critical crude protein level is 7% by DM of the diet. Below this feed intake is depressed as the cow can't digest feed quickly enough in turn production is depressed. As an example, batiki is the major pasture grass in Samoa and tends to have a low CP% which falls quickly with leaf age (and increasing stem). Grasses should be kept young and leafy with a short grazing interval.

12.2.5 Rotational Grazing

This type of grazing will allow the farmer to graze the pasture and then leave it to recover. Portable electric fences are an effective, low cost method of controlling the grazing area and daily pasture allocation.

The length (in days) of the rotation may have to vary a little

> **e.g. Shorter when the grass is tending to seed, this should help to promote vegetative growth.**

If conditions are dry, the rotation may have to lengthen a little so that, when the cows enter a new paddock they are offered the same amount of feed i.e. 25-30 cm high. This will mean leaving them on the paddock a little longer and therefore the "residuals' (amount of pasture left) will be less than usual. This is only recommended for a short time and supplements should be increased in this case.

Worm burdens tend be less under rotational than continuous grazing.

12.3 The Use of Fertiliser

It is widely accepted internationally that to achieve high production levels over the long term, fertiliser inputs are necessary. The basic idea being that something is being removed from the agrisystem i.e. coconuts, meat, milk, - then something must be returned i.e. essential nutrients N,P,K,S (+ micro nutrients) otherwise the productive capacity (soil fertility) will decline overtime. Perhaps this is best described as land stewardship: ensuring that you are able to hand the land to your children in at least as good a condition as you received it from your parents.

12.3.1 Maintenance Fertiliser

The principle of maintaining the productive capacity of the land should be followed, fertiliser policies which farmers can apply for pasture development and maintenance in all cattle raising areas need to be prepared, your MAF may be able to advise you on this.

12.3.2 Strategic Use of Fertiliser

Fertiliser can be used to boost pasture plant growth in order to overcome (quickly) problems such as short term feed shortages and weed problems.

Banana fertiliser (NPK: 12-5-20) has been shown (Lee SD 1995) to be highly beneficial in controlling mintweed *(H capucita)* and navua sedge *(K polyphylla)* in pastures. Spread at 100kg/ha, the fertiliser boosts batiki grass growth, enabling it to compete more strongly and thus smother (exclude from light) the 2 weed species. Note: Mintweed should be slashed to the ground at the time of fertiliser application. Also the cattle should be excluded from the area for about six weeks to allow the grass to grow.

13. WEED CONTROL

So long as an improved pasture has been established and managed with an appropriate SR (Stocking RATE). Weeds should not be a major problem. It cannot be too strongly stressed that good management is the key to avoiding the all too colon problem of weed dominated pastures in the South Pacific. Even with the right SR some weeds will grow, these should be controlled using recommended practices. In addition the following practices should become habit on the farm.

1. When cattle are shifted from one grazing area to another, the people who move the cattle should inspect the grazed area and pull any weeds present (woody weeds may be slashed). In this way a few minutes spent will prevent weeds from setting seed - spreading and becoming a major hard to fix problem.

2 In the case of guava *(psidium* guajava) see Photo 15. plants should be treated with Grazon/Garlon 600. In the case that some areas of the farm are clear of guava and others are not, the manager should avoid allowing cattle to eat fruits in one area and then move to another where there are no plants, as guava seed will be transported in the dung.

3. **Some plants, such as mile a minute *(Mikania micrantha)* can taint milk, that is give it a strange taste. It is important to avoid this as people will reject tainted milk. Large areas, or the weed growing on a fence line may have to be sprayed with butoxone. Generally grazing the paddock about 10 days ahead of the cows with non-milking cattle and ensuring that plenty of water is available Should fix the problem. The farmer Should look for any poisonous or milk tainting plants and remove them from the pasture.**

Photo 13. mile- a-minute, *Mikania micrantha*

1. **Navuia sedge [*Kyllinga polyphylla*]- see Photo 22. is an extremely serious problem if it becomes dominant on a farm. The manager should try very hard to prevent its establishment on the farm, digging up and burning and regular spraying of any plant seen on or close to the farm,**

If navua sedge becomes established on the farm, there is currently no economical way of chemically controlling it, the farmer will have to consider the options of increased fertiliser, pasture development and rotational grazing and may have to decrease the SR.

13.1 Weed Control in Pastures

A weed is often termed a plant in the wrong place.

Some plants that in other circumstances may be considered good are weeds in pastures e.g.

Guava *[Psidium guajava]* see Photo 15..

Most pasture weeds are exotic [introduced from other countries] and have found a position of competitive advantage in the local ecosystem, it is this success without practical use that make them a weed.

A weed is of no use for cattle food and may even be poisonous to livestock, e.g. Milk weed

***[Asclepias cutasavica]*- see Photo 19.. Weeds compete with pasture plants for light, water, space and soil nutrients resulting in less food available to cattle.**

Some plants which are not pasture, may not be considered weeds either, this 3rd group of plants are useful for providing beneficial effects for people and animals

such as fruit, nuts, timber, shade, medicines, improved soil conditions and aesthetic values. These plants Should be maintained as part of a diverse farming system and managed as a whole to provide for the needs of the farmer on an ongoing basis.

13.1.1 Theory of Weed Control

There are many ways of controlling weeds, but in the pastoral situation there are three major factors which if adhered to will radically simplify' the job and cut costs. Good management is the key to weed control, herbicides are most often required because things have gotten out of control.

1 Maintain a vigorous pasture at the appropriate stocking rate, this will allow the pasture to dominate and smother weeds or by giving a thick ground cover, deny weeds the chance to even germinate.

2 Control weeds early. It is much easier to pull out a weed the first time it appears in the pasture [or even close to the pasture] when there are only a few. If they are left to reproduce [i.e. to set seed], there will be thousands and the farmer will have a big job to control them.

3 Follow up. Often the first effort to control a weed invasion will be a large task, after this work is done ensure that improved pasture is established and institute management practices that will minimise weed re-invasion, this should include regularly checking the area for new weeds to be destroyed and a programmed 'follow up' campaign to kill any weed which did not die after the first application.

If weeds are allowed to dominate a pasture, income will suffer as pasture and consequently beef production falls.

Often weeds are not a big problem for cattle farmers: Those who have good improved pastures [such as batiki, signal, koronivia or splenda setaria with hetero, Glenn jointvetch, centro, siratro or greenleaf desmodium] which are not overgrazed are able to spend time controlling the few weeds they have before they get out of control. A grass with a strongly creeping growth habit tends to be most competitive against weeds in a grazed situation.

- Use the correct STOCKING RATE

+ A STRONG PASTURE THAT CAN COMPETE WITH WEEDS

= THIS IS A SIMPLE EXAMPLE OF A SYSTEM IN BALANCE

When the grazing intensity is too heavy the ground is left bare, this gives the opportunity to weed seeds to germinate [this is an example of a system out of balance]. Other factors may cause the ground to be left bare, in these cases it is recommended to plant pasture cuttings or another desirable crop in the soil to compete with weed growth.

in some cases, once a weed has become established, direct action be it cutting, pulling out or use of a herbicide is the only remedy, this is often the case with woody species. Slashing and pulling weeds is often the cheapest and most effective form of weed control where management alone fails. Where it is necessary to use chemical herbicides to control a weed, as a general mile this is best done by spraying regrowth after slashing as less chemical is required and the regrowing plant is easier to kill.

When slashing or pulling out weeds, it is a good practice to destroy plants which have seeds on, this is best done by homing.

Once an area has been cleared of a weed infestation, it is essential that ground

cover be re-established with an appropriate pasture grass and legume mix. Nature abhors a vacuum and if a desired plant is not planted weeds will quickly re-invade the area.

Always wear appropriate safety clothing and equipment when using herbicides long trousers and boots or shoes with socks are the very minimum, i.e. lavalava and jandals are not acceptable. Wash thoroughly after spraying. Always follow the manufacturers instructions on the herbicide pack label.

13.2 Some Common Weeds of Established Pastures and Their Control

Generally these weeds become a problem due to overgrazing and or lack of fertiliser. Some common weeds of pastures are:

Common name Botanical name

-wild peanut *Cassia tora*

-lantana *Lantana camara*

-guava *Psidium guajava*

-blueratstail *Stachytarpheta urticifolia*

-giant mimosa *Mimosa invisa*

-devils fig/pico S*olanum torvum*

-milkweed *Asclepias curasavica*

-mintweed , knobweed *Hyptis capitata*

-swordfern *Nephrolepsis hirsutula*

-navita sedge *Kyllinga polyphylla*

-honolulu rose Cl*erodendron fragrans*

-rubber tree *ficus* sp

-broom weed *Sida* sps

-tobacco weed *Pseudoelephantopus spicata*

13.2.1 Control of Individual Species

Following are control strategies for a limited range of important weeds found in Pacific Island dairy pastures.

1 Wild peanut [C*assia tora*] see Photo 13.

Infestations of this weed tend to have a very large store of viable seed in the ground. It appears that this seed may remain viable for a number of years.

Method of control

1 pull out plants as they appear

2 slash mature plants between flowering and pod set, and

spray regrowth after 3-4 weeks, and small plants with a wetting agent.

Herbicide Rate

-Butoxone 0.8% in water

[2,4-D+dicamba]

-Escort 0.5 g/litre water

2 Lantana [Lantana camara] see Photo 14.

Generally lantana is not a serious problem in areas where the beetle (fropiata was introduced in the 1970's which has proven an effective biological control agent. Where this bio-control is not in effect lantana is a serious bushy weed sometimes covering large areas of land.

Method of control

Slash and dig out roots, pullout any young plants. Spray actively growing regrowth.

Herbicide Rate

Butoxone 1.0% in water

3 Guava *[Psidium guajava]*- see Photo 15.

A very serious weed of pastures in many areas, sometimes forming impenetrable thickets of many hectares. Spreads quickly as cattle eat the fruit and distribute the seeds in the dung. It appears that seeds are also distributed by birds.

Method of control

Management- the farmer should attempt to stop spread of the weed by not allowing cattle access to unaffected areas if they have grazed areas where fruit are available, Interventions- slashing to ground level will promote better pasture growth and will slow the spread of the weed, however it will not kill the plant and must be done repeatedly. Some people report that cutting guava to ground level and then covering with soil is effective. There are several effective means of herbicidal control using triclopyr [as the butoxyethyl ester] this is marketed by Dow as Garlon and Grazon and has 600 g/litre ai.

I basal bark application, apply diesel mixture to the bottom 30cm [from ground level] of all stems of the plant, ensuring that an even coat around the tull circumference has been achieved. This is very quick and effective, requiring limited labour and as the plants are treated in-situ, access to the area is not hampered by slash on the ground. Application can be with a knapsack sprayer or paintbrush.

2 cut stump application, apply diesel mixture directly to the remaining stump *immediately* [within 15 seconds] after cutting the plant down close to the ground. Whilst requiring more labour for cutting the plant down, this is about twice as economical in its use of herbicide. Application can be with a knapsack sprayer, paintbrush or pump-spray bottle.

2 stem injection, after making a cut into the stem of the plant about 50cm above ground a measured 2.5m1 of diesel mixture is poured onto the blade of the bush knife before it is withdrawn from the cut. Iii this way the chemical is taken directly into the plants system, via the fresh cut. Whilst successful results have been obtained from this method, more work needs to be done to fine tune recommendations. It appears a method with great promise for dealing with larger plants and should prove very economical.

Herbicide Rate

arlon/Grazon 5% in diesel

600g/l triclopyr

4 Blue ratstail *[Stachytarpheta urticifolia]* see Photo 16.

Method of control

Pull plants out where possible, if there are many plants spraying may be necessary. Young plants of less than 0.5m can be sprayed directly whilst larger plants should be slashed and the actively growing regrowth sprayed [after about 3-4 weeks]

Herbicide Rate

Butoxone 0.8%

5; Giant mimosa *[Mimosa in visa]* see Photo 17.

In a pasture situation, slashing will give adequate control in some countries whilst

in others a herbicide is required. In Samoa appears that grazing and physical damage by cattle keep this weed in check, also the author has noticed loss of vigour in some stands of *Mimosa invisa* accompanied by many small [@I nim] black lesions on the stem which suggests that some biological control agent is at work.

If spraying is necessary, the following are recommended:

Herbicide Rate

Butoxone 0.8% in water

Escort O,25g/l in water

6* Devils fig/pico *[Solanum torvum]

This is found most often in seasonally dry areas, where it can form quite dense thickets and

radically reduce available pasta re.

Method of control

Pull out plants where possible. Slash to 0.^{7}5m and spray actively growing regrowth.

Herbicide Rate

Butoxone I .0% in water

7 Honolulu rose *[Chlerodendron fragrans] see* Photo 18.

This is a very serious weed in pastures throughout many parts of the Pacific. It is remarkable in its ability to spread vegetatively as it bears no seed. Once established by an accidentally introduced root cutting or by spreading from neighbouring land honolulu rose spreads rapidly by stolons. It rapidly forms a dense thicket of approx. 5m high smothering all plants of lesser height.

Method of control

A Where there are only a few plants, pull them out and plant the area with grass

such as batiki or signal. This is best done before the weed actually spreads in the pasture area.

B If the area is to large to hand pull, herbicide may be needed. Slash plants to 15cm

2 Wait until it grows back to 0.4m -0.5m and leaf'.

3 Spray with herbicide.[as below]

4 3 - 4 days post spraying plant a pasture grass such as batiki or signal [and legumes] on

the sprayed area. This is most important when controlling weeds, using any technique you

must replace the weed with a useful plant otherwise the same or another weed will grow back.

Follow up is essential to ensure that all plants in the treated area are killed.

Another promising variation is to plant the pasture grass at the time of slashing, then when spraying is carried out pasture will establish more quickly. Because of the nature of the herbicides used, legume planting must be delayed until after spraying. It is reported from Fiji that painting stumps with diesel straight after slashing is effective in killing Honolulu rose,

Herbicide Rate

Butoxone 1.0% in water

Escort 0.5 g/l in water

8 Milk weed *[Asclepias curasavica]-see* Photo 19.

This weed is poisonous to cattle although the author has no record of reported stock deaths

from eating the plant in W Samoa.

Method of control

Pull it out.

9a Mintweed [Hyptis capitata]- see Photo 20.

This weak perennial heavy seeding weed spreads very quickly and is unpalatable to cattle. It forms dense thickets to 2. Same height and spreads rapidly high rainfall areas.

Method of control

I Remove any plant as soon as it is seen. Pull them out or dig them up.

2 With larger areas, slash to 15cm and spray the regrowth after about 4 weeks.

3 In an established pasture, slashing as low as possible followed by the application of fertiliser [100kg/ha banana fertiliser has been effective] and withdrawing the area from grazing for 4 - 6 weeks to allow the pasture to smother further mintweed growth.

It is vital that after pulling or spraying mintweed pasture be planted on the bare ground e.g. batiki [+ legumes]

Herbicide Rate

Butoxone 0.8% in water

9b Hyptis pectinata also sometimes called mintweed

This is a close relative of H capitata it is it can be easily distinguished by its smaller leaves,

more slender growth habit and different seed head. It is a common weed but more

easily controlled than H capitata, generally slashing or pulling [before seed is set] will give good control.

10 Swordfern *[Nephrolepsis hirsutula - see* Photo 21.

Generally a sign of overgrazing, lack of fertiliser and or low soil pH. Method of control

Slashing and planting batiki grass whilst [at least temporarily] reducing stocking rate is the most effective short term practice. In the longer term use of fertiliser, increasing the soil pH by spreading coral sand and setting an appropriate stocking rate are recommended. No herbicidal treatment is recommended as swordfern is always associated with problems associated with poor management and fertility.

11 Navua sedge *[Kyllinga polyphylla]* see Photo 22.

This is a very serious and difficult to manage weed in pastures of higher rainfall areas. It spreads quickly by seed and stolons, and is very difficult to eradicate by any method once established.

Method of control

1 Small areas should be dug up and one should ensure that the roots dry and die [or are burnt], plants in common ground, access roads or neighbours land should be destroyed before they spread into the pasture.

2 Rotational grazing with a rotation length of approx. 50 days, fertiliser [100 kg/ha banana fertiliser] and reduced stocking rate will allow a batiki pasture to recover from virtually complete domination by navua sedge in 6 - 9 months.

3 Chemical control is appropriate for small areas, often 2 applications of glyphosate [Sting/Roundup] is necessary. This will also kill the pasture so it Should be replanted. Spraying should not be delayed, but is most effective when 1/3 of plants are flowering and actively growing.

Herbicide Rate

Sting 2.0% in water

4 in Fiji, planting of splenda setaria has successfully smothered navua sedge - producing a highly productive, weed free pasture.

12 Tobacco weed *[Pseudoelephantopus spicata* see Photo 23.

This plant generally becomes dominant in seasonally dry areas where overgrazing is practised.

Method of control

Reduce stocking rate

and plant improved pasture such as signal, koronivia, Bisset creeping blue grass, or [with legumes]

Should the use of a herbicide be chosen, steps 1 & 2 should be followed afterward.

Herbicide Rate

Butoxone 1.0%- 1.5%

13 Rubber tree *[Ficus sp]*

This should be treated in the same way as guava: *Psidium guajava,* although it is not necessary to limit the movement of cattle which have had access to the plant as

the plant is not palatable and cattle do not appear to have any role in the spread of seed which is wind born and produced in huge numbers.

14 Broom weed *[Sida sps]* - see Photo 24.

There are 3-4 similar species of economic importance. They should be treated in the same way as blueratstail: *Stachytarpheta urticifolia*.

14. ALTERNATIVES TO FENCED GRAZING SYSTEMS

Whilst the fenced pasture system is very effective, there are other very useful methods of feeding that a dairy farmer may use instead of, or as a supplement to fenced grazing.

This may be done year round or in response to a particular need, such as feed shortage during the dry season. In order to obtain good levels of milk production, all dairy farmers should be using supplements to pasture feeding.

14.1 Concentrate Feeds

It is difficult to get the 'perfect feed' from one source. That is a feed which has all

the correct components of protein, energy, minerals etc. in adequate balance and quantity to promote maximum animal production [milk].

Protein tends to be what most tropical forages are most lacking, also they are often bulky and slow to digest, therefore the cow cannot actually eat enough of the available feed to optimise her performance.

Using a high protein, easily digested dry feed to supplement the cows intake can be a very profitable way of producing more milk. The farmer needs to be aware of the cost of feed and the benefit gained in extra $'s of milk per extra $ of concentrate fed.

In many cases concentrate feed has to be imported, however inexpensive, good quality supplements can be made by farmers using locally available materials.

14.2 Mineral Supplements

Cattle require a balanced intake of minerals such as [but not limited to] Sodium, Phosphate, Copper, Zinc, Cobalt, Selenium, Iodine in varying quantities. Sometimes adequate minerals can be had from the normal diet, but often supplementing the

diet with a multi-mineral salt lick block increases stock health and production.

Sometimes the lack of one single micro-element such as copper can seriously affect the health and production of cattle. If cattle seem generally unhealthy [dull coat, thin etc.] despite being offered enough feed, then it is recommended that the farmer find if a mineral deficiency is likely and if so, give appropriate supplementary minerals.

14.3 Crop Residues and Industrial By-products

Sometimes unsaleable or excess crops such as squash or manioc, or unused parts of crops such as kumara leaves or banana stems can be used. Some by-products such as spent grain from the brewery make excellent cattle feed. This is dealt with in greater detail elsewhere in this book,

14.4 Cut and Carry

This feeding method is widely practised by smallholders in many countries and is well suited to small scale dairy production where access to grazing land is in short supply. It may be used to provide the complete requirements of cattle kept in a shaded yard or house (zero grazing) or it may be used to supplement to grazing.

Suitable varieties for cut and carry are available these include:

elephant grass Guatemala grass guinea grass paragrass splenda setaria

daddap

locally occurring tree legumes such as Albizia chinensis and Adanonihera sps leucaena

Calliandra

Pueraria

Vigna sps

Gliricidia

The grasses should be fed in the green, leaf' state. Chopping the plants and feeding in troughs will ensure less wastage. Often enough feed can be gathered from waste ground and roadsides, however a farmer with a small area of land (say I ha) can, by using intensive cut and carry, achieve high effective stocking rates and production per ha. Provided good management.

Example:

A dairy farmer in Thailand grew I ha of guinea grass (P maximum) between rows of trees 125 kg ha urea was applied and the grass cut every 30-40 days. This produced enough to feed ~ cows producing 10-12 litres of milk per day. This same land had the Stocking Rate capacity for grazing of 2 cows per hectare.

The advantages and disadvantages of cut and carry <u>For</u>

-efficient use of forage.

-less wastage from trampling.

-saving of grazing energy.

-less soil damage

-less labour required to herd stock.

-water reticulation not required.

-less capital needed on fencing.

<u>Against</u>

-higher labour input needed to cut-and-carry fodder.

-greater labour resources needed to dispose of excreta.

-more capital required in structures, equipment and possibly fuel costs.

-less opportunity for animals to select forage.

-cutters may select low quality feed.

-too little feed may be given to animals.

-urine may be lost and dung may be returned to areas other than forage

producing areas resulting in soil fertility decline.

-animals may need supplementation with coconut cake, rice bran, etc.

Photo 25. mechanised chopping of splenda setaria in Fiji

14.5 Tethering

Tethering is well suited to small farmers, with

- few cattle

- limited money for building fences

- small and or scattered areas of land

- access to fallow cropping areas and communal grazing areas

- cut and carry systems

However the following points need to be emphasised

- Cattle must be checked regularly ~ least once a day to ensure problems such as the animal becoming caught on its own rope have not occurred.

- Adequate quantity and quality of water must be available.

- The animal should be offered good quality leaf' feed.

- The animal should be offered plenty of feed and moved to a new position as soon as the current grazing is grazed down (height depends on pasture variety. e.g. batiki 15 cm, elephant 50 cm).

Tethering is best considered a rotational grazing system and the guidelines for pasture quality, growth stage, legume content and rotation length are the same.

14.6 Waler requirements of cattle

Cattle should get adequate, unpolluted water every day.

The approximate requirement are as follows.

Class	Litres per Day
Calves	22
1 yr old	35
2 yr old	45
dry cows and bulls	45
milking cows	70

Table 6.

14.7 The Effect of Heat

Cattle must not only cope with the heat influence of the sun, i.e. the ambient temperature, they must also cope with the heat produced internally as a product of digestion.

Often the problem of production is that cows won't or can't eat enough feed to maximise their milk yield. We have already mentioned the limitations associated with low quantity feed. Cows also stop eating to avoid over-heating, in the simplest terms cattle eat to keep warm, in a tropical climate cattle attempt to regulate their body heat by reducing or stopping eating.

Lower quality feeds (i.e. lower CP% and % digestibility) require greater energy to digest and result in more heat released internally. Bos Taurus type cattle are considered more prone to heat stress.

The following actions can be taken to minimise the stressful effects of heat.

1. Feed high protein highly digestible feeds

i.e.:

- high legume content pasture

- cut and carry legume foliage (fresh)

- high protein supplements

- silage

2. Allow best feeding opportunities at night

- put cows onto new pasture after the evening milking

- feed more supplement at the afternoon milking.

3. Provide ample shade

- coconut plantations are ideal

- shade trees are useful.

- keep cows under shade while they wait to be milked e.g. under a tree.

4. Washing cows down with water helps to cool them.

5. Provide ample, cool, clean water to drink.

15. A FEW FACTS ABOUT HIGH PRODUCING DAIRY COWS

15.1 Feed Conversion

The advantage of using dairy breed cattle is that they are capable of converting a higher percentage of the feed that they consume into milk. A heifer that reaches her target weight of 350 kg at mating has the best chance of reaching her potential life times production. Not just any cow, can fulfil her owners wishes of high production, purpose bred dairy cattle are needed, as they when well managed have special advantage.

Dairy breed cows have a superior ability to utilise body reserves.

A farmer will notice that it is in mid lactation that the cows appetite reaches its highest, this is after the period of highest milk production. This is because a good dairy bred cow will use her own body reserves (fat) to produce milk.

Figure 15. Partition by the cow of feed in early lactation

During the mid to late period of lactation the cow will produce less milk and begin to build up her body reserves. This build up of reserves enables her to care for her new calf

Figure 16. Partition of feed by the cow in mid-late lactation

Source of figs 15 &16: Balch, C.C. 1988 - Meeting the dietary needs. A high producing cows in intensively farmed pen - urban areas.

The characteristics of a high quality cow are

1. Well grown at first calving

2. Ability to produce calves at regular intervals

3. Good appetite

4 Ability to utilise body reserves.

15.2 Body Condition Scoring

In managing a cow the farmer should be constantly checking the body condition of a cow. A useful method is the NIRD body condition score system [below].

Figure 17.

source. Balch, C.C. - Dairy Cattle Feeding and Nutrition.

These diagrams represented the shape, skin and fat thickness of the cow just in front of the tail.

In the simplest terms a cow of

Score 4: is too fat and probably has not been in calf for a long time, care should be taken to ensure she gets in calf

Score 3: A cow in good condition

Score 2: This cow has probably used some of her reserves to produce milk

Score 1: This cow is excessively thin and will probably require extra feeding and time before she can produce a calf again.

16.0 FINANCIAL ASSESSMENT OF SMALLHOLDER DAIRY FARMING IN A

PACIFIC ISLAND SETTING [using Samoa as an example]

Because most Samoan farmers have many enterprises operating at the same time, it is difficult to judge exactly the effect of introducing a new activity. This will affect the overall farm system in terms of the way in which resources like land, labour and money are used so the outcome of other enterprises will change. A farmer will want to maximise the benefit from the whole farming system. Below is a simplified example just looking at cattle [beef Vs dairy] and cop RA [selling husked nuts].

16.1 A GROSS MARGIN FOR A SMALL DAIRY FARM (for simplicity no deaths are included)

This is the same farm as referred to in Section 12.2. This farm has "good average" management and a full cover of batiki/hetero pasture. Currency is Samoan Tala

[US$ 1 = S$ 2.50]

Farm of 12 ha: 9ha coconuts 2 au/ha 18

3ha open 2.5 7.5

25.5 au total carrying capacity

1. Stock Carried Number au/animal Total au = 25

Calves	h	5	0.22
	b	5	0.22
yrlg	h	4	0.56
	b	1	0.56
2yr	h	4	1.0
MA cows		13	1.11
Bulls		1	1.56

2. Income

Stock Sales- 5 bull calves 500 2500

1 heifer calf 500 500

1 2 yrs dry heifer 1000 1000

3 old cows 900 2700

6700

Milk $O.85/litre - net on farm

> ***2,000 1 per lactation - 420 day Cl [calving interval] = 0.87 lactation/cow/year***
>
> ***= $l,479 per cow***

13 cows milked 19,227

Copra 9 ha X 3000 nuts/ha/year @ $0.13 ea. 3,510

Gross Income 29,437

3. Costs

Labour 3 units @ $60 per week each (Family) 9,360

Stock purchases 1 yrlg bull 800

Animal health $30 per cow = 390

$10 per calf = 100 490

Weed control

Chemical fence spray $50, spot spraying $150 = 200

Feed Calves [milk] 10 X 56 day @ 54.0 1 day = 2800 @ 0.65 5 l = 1,820

Cows [meal] 10 X 200 days @4 kg day = l0.400 kg ~0.30 c kg = 3,120

Calves [meal] 10 X 150 days @ 1 kg day 1 500kg @ 0.3oskg = 450

Maintenance

Fences 300

Buildings 300 600

Total Farm Expenses 16,840

Farm Surplus 12,597

16.2 BEEF PRODUCTION ON THE SAME FARM (12 ha)

Selling steers for beef and (in calf) heifers for breeding at 2 years

1. Stock Total au = 26

heifer calves 4

bull calves 4

h yrlgs 4

Strs yrlgs 4

Strs 2 yr 4

MA Cows 9

MA bull 1

Yrlg bull 1

For simplicity the same animal unit values and calving interval as the dairy farm example are used.

2. Income

Calves born 40 kg, growth rate 0.4 kg per day, meat price $3/lb.

Stock Sales (allow $20 per animal for Transport)

4 X 2 yr steers @ $1449 = 5,796

2X2 yr heifers @ $l449 = 2,898

2X Old cows @ $l000 = 2,000

10,694

Copra

9 ha X 3000/ha/year @ $0.13 = 3,510

picking up and selling for coconut cream)

Total Farm Income 14,204

3. Costs

Labour

2 units @ $60 per week each (family) 6,240

Stock purchases

1 yearling bull 800

Animal Health $10 au 250

Weed control (herbicides) 200

Maintenance and Stockyard 400

Total Farm Expenses 7,890

FARM SURPLUS 6,314

16.3 ANALYSIS OF RETURNS

16.3.1 Comparing Smallholder beef to Smallholder dairy

(based on the example above)

Gross Margin per hectare

Beef $ 526.16

Dairy $1,049.. 75

Gross Margin per au

Beef $ 242.85

Dairy $ 503.88

16.3.2 SENSITIVITY ANALYSIS

Gross Margins at differing levels of animal performance and price

Table 7. Price received per Animal

		Beef Price $ lb ($ Kg)	
		2.60	3.00
		(5.72)	(6.66)
Animal growth rate kg/day	0.2	700.13	815.18
	0.4	1273.27	1469.16
	0.6	1721.49	1986.34

Table 8 - Gross Margin per animal unit

		Beef Price $ lb ($ Kg)	
		2.60	3.00
		(5.72)	(6.66)
Animal growth rate kg/day	0.2	70.03	96.58
	0.4	202.29	247.50
	0.6	305.73	366.85

Table 9 - Income per cow from milk sales in a year

		Milk Price $ /litre

Annual per cow		0.55	0.85
Production in litres =	870	478.50	739.50
[Lactation total x Calving interval factor	1740	957.00	1479
(365 - 420 = .89)]	2349	1292	1996.65

17.0 SUPPLEMENTARY FEEDING

A practical Feeding Guide For Dairy Smallholders in Pacific Island Countries,

highlighting the use of various by-products and locally available foodstuffs for dairy cattle.

Based on observations made, and field work done in Samoa.

17.1 General principles

Livestock husbandry and management is the process of keeping and caring for animals. Good

husbandry practices are necessary to maintain stock in good health and condition for breeding,

working and consumption or sale. There are three main principles to livestock husbandry and management:

- feeding

- reproduction and breeding

- livestock management: health, housing, herding, animal product collection, recording.

etc.

The major factor affecting the profitability of a dairy cattle farm is timely provision

of feed to meet livestock nutritional requirements. This output must be adequate in both nutritional and economic terms. Considerable work has been undertaken to obtain precise estimates of nutritional requirements for all categories of cattle and for the calculation of optimal rations. However, in order for the dairy farmer to undertake the feeding of dairy herd effectively and with confidence. it is necessary to first understand some of the principles of feeding.

17.1.1 Feeding

This is the most important of the three factors mentioned above. Poor nutrition of animals results when.

- insufficient quantity of feed is supplied to them,

- foodstuffs used are of poor quality. either of low protein content, or low digestibility or lacking

adequate balance among nutrients required by particular categories of animals at a certain time.

- Unbalanced rations are fed which lead to wastage of part of feed inputs and poor

performance.

This happens because unbalanced rations do not meet the overall nutritional requirement of the animal

Performance levels displayed by animals kept on good diets, compared to those of animals which are underfed or given diets of poor quality. are distinctly better, well fed animals will

- look better and show relaxed behaviour: appealing coat colours. well fleshed bodies.,

alert and active

- produce more milk

- grow faster

- work longer and better

- show greater resistance to infectious and enjoy better health

- when lactating will produce morn milk for their offspring

- fetch better prices when sold

Livestock must be maintained productive and in healthy condition by good feeding; but farmers cannot afford to waste feed by overfeeding Each category of animals require (different quantities and quality of feed at specific periods. therefore the farmer needs to have

- a clear understanding of feed quality

- good knowledge of livestock feed requirement

- the means to control feed intake by livestock

Extension workers should have a good knowledge of the differences among foodstuffs and among categories of livestock so that he can assist the farmers. Improved animal nutrition and feeding strategies for livestock in the Pacific would do more to increase production of livestock than any other factor. Improved feeding together with improved herd management and disease control programs would increase benefits from investments in genetic improvement, disease control programme and up-grading infrastructure and facilities.

17.2 How do cows use feed through their digestive system ?

For the purposes of feeding and management farm animals can be divided into two main categories according to the type of digestive system that they have. The two types are known as RUMINANTS or POLYGASTRICS (these animals store large quantities of feed in their rumen, and can later on bring it back for re-chewing; when this happens the animal starts to rummage eaten forage) and NON RUMINANTS or MONOGASTRICS (for example pigs and young suckling calf). A simplified diagram of the stomach cow is shown in figure 18. There is a very important difference between these two types of digestive systems in practice and

is related to the type of feed that animals can eat and digest. The ruminant's stomach or abomasum, small intestines and colon or large intestines are all sections of the digestive system that are similar to those found in non-ruminants. The most significant distinctive feature of the digestive system of ruminants, when compared to monogastrics, is the presence of three additional compartments situated between the oesophagus and the abomasum; these compartments are especially adapted for the break down of bulky and fibrous plant material to compounds that can be digested by these animals.

Their names are: Rumen, Reticulum, Omasum

Figure 18. The digestive tract of a cow

The rumen and reticulum, are large sacks that contain a mixture of solid contents eaten by the animal and fluids containing millions of micro-organisms. Under these conditions micro-organisms assisted by enzyme actions can attack, break down and digest plant material that is rich in fibre; this allows micro-organisms to reproduce themselves and at the same time they transform plant material into a fine mass. The walls of the rumen and reticulum are very active;

they are constantly moving, chumming and mixing the feed that is being fermented by micro-organisms, and thus helping the animal to digest its feed.

After grazing and eating other foodstuffs is finished, animals will rest and ruminate or chew their cud while lying down. Rumination is the action occurring when the animal brings feed back, mainly the larger sized pieces, from the rumen to its mouth in order to re-chew it. The chewing action mixes cud with saliva which facilitates further breakdown feed material. Large amounts of saliva are produced from the glands in the mouth (up to 100 litres per day in a high-yielding cow) containing water, enzymes and salts. The former play a key role in buffering acids formed in the rumen during digestion and this therefore keep microbes working at their full capacity. Gases such as carbon dioxide and methane are produced during fermentation and these, in the healthy animal, are removed by belching or during rumination. Bloat is a serious problem and it occurs when an animal is unable to remove gases by normal belching.

A regular supply of fibrous feed keeps the rumen functioning well; rumination proceeds normally and it prevents bloat from occurring. Rumination is a very important activity in the digestive process; it improves the efficiency and rate of digestion. The micro-organisms of the rumen and reticulum are vital to the

digestive process; by retaining a relatively stable population of micro-organisms (sufficient production of saliva), in active condition (regular supply of good quality feed) allows a very active digestion activity of feed to take place (mainly fibrous plant materials) and a high biomass production of microbial protein. The type of feed eaten by the animal is an important factor in determining its rate of breakdown -digestion and this in turn determines the amount of energy made available to the animal for maintenance, growth, work and reproduction. For example concentrate foodstuffs: such as cereals and crop roots, and molasses are broken down rapidly, whereas bulky forage , namely feeds which are rich in fibre, are degraded much more slowly.

Grass and other feed that are eaten by the animal are then retained in the rumen and reticulum

long enough to them to be broken down to small particles that can then pass into the Omasum.

About 50 - 70% of the feed eaten is actually absorbed by the animal direct from the rumen into

the blood, to provide the animal energy requirement, or passed out of the animal as gas by belching. The remaining 30 - 50% passes on to the Omasum and later to the small intestines where digestion activity becomes similar to that occurring in non ruminants. Microbial proteins

produced in the reticulo-rumen are also digested and absorbed and therefore they contribute a substantial portion to meet the animal's protein requirements.

> ***In conclusion this difference in the digestive system of ruminants, compared to that of non***

ruminants (including man), allows ruminants to utilise quite different types of feed to that eaten by non ruminants. Ruminants are only able to take advantage of bulky, fibre-rich forages due to their special digestive system. The simultaneous effects of rumination and microbial fermentation, which take place in their reticulo-rumen through the action of the hosted micro-organisms, enables these forages to be degraded into tine particles, for the chemical material to be broken down to simpler forms and for the nutritive elements to be extracted and absorbed by the animal. These nutritive elements are placed at the disposal of the animal through end products from this resonation process; these end products are made up of

volatile fatty acids (VFA) and microbial mailer, which is itself digested later on by enzymes in the abomasum - the true stomach - and the large intestine.

18.0 FEED QUALITY

Feeds are complex materials; different foodstuffs have quite specific physical and chemical characteristics that affect the results of the animal nutrition process. Knowledge of the type of feed eaten by the animal is very important when calculating their rations and in determining how to best meet the amount of nutrients required for animal maintenance and production.

18.1 The physical characteristics of forage

The walls of plant cells are rich in fibre and they are broken down by the action of enzymes; these come from micro-organisms living in the rumen. After the wall is broken down substances inside the plant cells (cell contents) are released, they become accessible and are

readily digested by the animals. As grasses and crop plants grow and mature, changes take place in the structure and content of their cells that affect their digestibility by animals. As the plant matures, weight proportions among leaf sheath stem show changes; these are slow at first but become more rapidly as the plant begins to set seed.

The maturation process brings about a general decline in the digestibility of each of these plant component parts. This is due to an increase in the cell wall of complex carbohydrates (fibre) that causes thickening and hardening of plant material. This is partly due to a non digestible component called lignin. As maturation takes place, the proportion of cell contents that are readily digestible parts of the plant, decline. In addition, as the plant matures the weight proportion of stem increases and that of leaf declines. For example: in Samoa this phenomenon Is very intense and clearly visible during dry season (May June and July) when fodder production levels from annual and perennial graminae in both natural pastures and improved grasses as Batiki Bluegrass (Ischaemum aristatum) tend to fall markedly as plants prepare to seed. At this stage low feed digestibility and intake levels are widely observed.

Legumes have higher digestibility than grasses and at a comparable age their plant structure shows different growth characteristics. They continue to produce vegetative, leafy growth without much change even during flowering. This difference between legumes and grasses Is very important in animal nutrition. A relatively small proportion of high quality legumes in a grass-legume mix pasture, can greatly increase the feed value, compared with grass alone. Likewise the provision of feed supplements to unbalanced rations containing low quality forages would boost rumen microbial activities and digestion; this would cause intake levels to be improved substantially. There is a wide range of foodstuffs options in Island Countries which are found in residues from cropping systems and in by-products from food processing results from food crops; these have a high potentially value as feed supplements. Common are:

copra meal, spent grain, cassava leaves and roots, rejected banana and banana pseudostems, rejected squash, molasses, fish waste, breadfruit, mill by-products.

When animals eat feed of relatively low energy value (low digestible energy), its passage through the digestive system of the animal is slow compared with feed

that is easily digestible. The effect of this slow passage is to reduce the appetite of animal. The combined effects of reduced appetite, reduced feed intake and slow release of digestible energy, that results from feeding of poor quality feed, reduces weight gain, milk production and/or work output of the animal. Ruminants can eat a large amount of poor quality feed but it is of very limited value to them because they have to make a great effort and spend much energy in digesting such material. When good quality feed is in short supply, a good strategy is to give the better feed to animals categories which will gain the most benefit - i.e.: weaned calves, pregnant cows and lactating cows.

18.2. Chemical composition of foodstuffs

Foodstuffs are complex both in composition and structure. It is convenient to classify the various foodstuffs in groups having similar physical or chemical characteristics, The two main components of foodstuffs are: water and dry mailer.

18.2.1. Water

Clean fresh water is required by all animals in addition to that obtained from the feed they eat.

The water content of feeds varies greatly e.g. from 80 to 90% of the total weight of the fresh green grass, root leaves, banana pseudostems, bananas skin; 75 to 50% of the weight of <(semi-dry " breadfruit, root crops; rejected bananas; down to as low as 8% to 12% of " dry>) feed such as copra meal and dried root crops.

The drier the feed that is fed to livestock, the greater the amount of additional water required by the animal to maintain water content in its body. Shortage of water can severely reduce growth, milk production and work output. Because of the very variable content of water in different feeds one can normally refer to the feed intake by animals in terms of kilograms (kg) of dry matter (DM). For example the water requirement of dairy cows varies from 5 to 8 litres per each kilogram of dry mailer eaten.

18.2.2: Dry Matter

This is made tip of (i) organic mailer and (ii) inorganic mailer. Inorganic mailer contains macro-elements namely minerals such as calcium, phosphorus, sodium and other trace elements. Organic mailer is made up of materials that are produced during the development process of the plant. The organic content is by far the most important element to meet the needs of livestock nutrition and in large grazing animals it represents almost its entire feed intake. Organic mailer is composed mainly by the following elements:

a. Carbohydrates and fats (lipids)

Dry mailer content in plants is made of tip to 70 - 80 % of carbohydrates. These substances

derive from the end product of photosynthesis, a plant process which combines energy from

sunlight, water and carbon dioxide (C02) to produce a simple sugar. Lipids [fats] are present

in plants but in much smaller quantities , about 5% to 10% of dry mailer. After digestion and

absorption both carbohydrates and fats are used by the body to provide the energy that is

necessary for all muscular activity (including digestion), to generate warmth and to fuel all vital body activities. Any surplus energy may be stored as surplus fat in fairly tissues or

elsewhere in the body. Ruminant feeds are often classified according to the quality of their

carbohydrates:

(i) Concentrate foodstuffs have a high content of rich-carbohydrate components u'~ the form of various sugars and starch which make up the greater part of cereal grains and root crops. They are readily and almost entirely digested in the rumen. However when large amounts of concentrates are included in a ration (up to 50% on dry mailer basis) the rapidly fermentable qualities of rich carbohydrates will cause a significant drop in acidity levels of the rumen; this can depress growth of rumen microbes, and if this activity is reduced it results in decrease forage digestion and intake will drop. A practical consequence of this observation is that these feed supplements should not be fed in large quantities in just one daily feeding; it is best to feed it in fractionated rations each day or even better, by continuous mixing feed concentrates with the basic ration.

(ii) The chemical composition of cell walls of plants corresponds to complex carbohydrate substances mainly in the form of cellulose, hemicellulose and lignin The fibre of dry plant material is composed by these substances, they represent the main constituent of forage. Fibre contents in forage is highly dependant on the maturity stage of the specific plant. Fibre contents are digested much

more slowly in the rumen than the carbohydrate types found in concentrates and they are therefore the most important factor that control the speed of the digestion process and that therefore determine intake levels of forage by the animal.

b. PROTEIN

Protein content in foodstuffs is normally measured as a crude protein ". This protein level estimate is calculated by measuring the amount of nitrogen content and applying a factor of 6.25. The average nitrogen content of proteins is 16% therefore Total Crude Protein (% CP.) = % N X 6.25. while not all protein types in plants are of equal value to different categories of animals, this estimate is in practice a useful indicator. During digestion protein is broken down into its component parts known as anuno- acids. These are then absorbed and used by the animal for building body tissue, milk production, and other vital body activities.

In most grasses and other green feeds only a part of the nitrogen provision comes from protein; the

balance consists of inorganic nitrogen, salts, amino nitrogen, amides and other forms. This difference in origin does not affect, however, the digestive process of protein in ruminants because these animals can utilise inorganic nitrogen as well as protein nitrogen through the microbial activity in the rumen. Bacteria in the rumen thrive on the non-protein nitrogen and incorporate it in the production process of their own proteins. The protein content in the bodies of microbes is then digested in the intestinal tract of the ruminant and absorbed there; the same thing happens to the fraction of feed protein that has escaped microbial degradation in the rumen and has reached the intestine. Hence as ruminants can be assisted by hosted microbes to digest cheap sources of nitrogen and from it build protein, expensive true protein supplements are not essential to them and can be saved to feed non-ruminant categories of livestock. This ruminant

feed strategy is particularly true at a low level of ruminant productivity.

In ruminant nutrition, fertiliser grade urea is the most frequently used supplement source of inorganic nitrogen. Urea contains 46% nitrogen, therefore each kilogram of urea is equivalent to 2875 g of crude protein (6.25 X 460 g Nitrogen = 2875 g Crude Protein). This content should be compared to composition levels of other foodstuffs, which are indicated in Table 13; for instance each kg of dry mailer of: (i) young batiki bluegrass, at 8 weeks, contains 75 g CP.; copra meal contains 205 g CP. and Spent grain contains 260 g CP.

The crude protein content of foodstuffs varies according to the type of fodder and in growing plants, with the stage of maturity. Young growing grasses have CP. percentage content ranging from 8 - 16 %, while grass legume mixtures can reach up to 25 %. But mature grasses only have CP. levels of 3.5 - 8 %. As an example, during early dry season in Samoa (May, June and July) crude protein content in batiki bluegrass is dramatically decreased and ranges only between 3~9 and 5.3%. Molasses show low levels of CP., usually less than 2%; root crops (cassava, yams, potato, taro) and bananas by-products are less than 5% CP., Breadfruit and Cocoa

Pods have 5 - 7% CP. Copra meal has 20.5% CP., Spent grain has 26.5% CP., while Cassava leaves have 23.5% CP. and poultry litter has 26.5% CP. Feed additives such as fish meal have 45 - 68% CP.

Growing and lactating animals require higher levels of protein in their diets Thus adding rich-protein supplements to the diet of animals grazing native and improved grasses under coconut plantation can improve substantially the nutritive value of these feeds.

19.0 FEED UTILIZATION

The ruminant needs a daily supply of nutrients required for maintenance and production. Their diets must provide all components required in vital activities linked with growth, pregnancy, plus milk and meat production.

19.1 Maintenance:

This is the energy required just to keep the animal alive for movement, production of body warmth, respiration and for the maintenance of body tissue without increasing or decreasing body weight. If the feed supply is insufficient for maintenance, the animal will begin to metabolise its stored body fat and in cases of severe feed shortage, its muscular tissue as well. This results liveweight loss. The amount of energy (feed) required for maintenance depends on:

- Size: the larger the animal, the higher its maintenance requirement. This is an important consideration when thinking of using large crossbred cable, instead of local stock..

- Age: Young animals need proportionally more feed for maintenance and of better quality than older animals. This applies to animals of the same size.

- Climate: The energy required for body heating is higher in cool weather and daring the rainy season.

- Husbandry system: Penned or tethered animals are restricted in their movement and so use less energy. However they can only eat and depend

on the feed brought to them, whereas free ranging animals can search for feed.

-

- Type of food: Feed with a high fibre content e.g. old mature grass, require more

energy to be broken down into its basic components in the rumen than better quality

feed such as fresh pasture or concentrates.

19.2 Growth:

Growth can be defined as the increase in body size in a young animal; to achieve this energy is

required for the production of new body tissue, bone and muscle. The rate of growth is

important as it determines

(i) The age when the animal reaches suitable weight for sale for slaughter and

(ii) Body weight is important in determining the moment when an animal can commence

breeding. Younger animals should be given high quality feed, especially at weaning, to ensure a good rate of growth.

19.3 Milk Production

Calves suckling badly fed cows are usually unable to receive enough milk from their dams for normal growth. Milk production stops if feed supply becomes extremely poor. If calves are very young when this happens, they may die. If severe feed shortage occurs when the calves are older it is preferable to wean the calves and give them priority access to supplementary feed of good quality and feed the poor rations to the dry cows. when cows suckling calves are poorly fed they will often

stop heat cycle activity, and will only return to breeding after the calf is weaned.

19.4 Reproduction

The quantity and quality of the feed ingested will influence the weight of the growing heifer. This determines when she will come on heat for the first time and prepare to commence breeding. inadequate feed when she is growing can delay successful breeding by up to one year. Nutrition also controls the presence of heat cycles after calving. Poor nutrition rules out mating for up to six months after she has calved and it can influence whether the mating is or is not fertile. Well fed cows should be able to mate with the bull about two months after they have calved and this mating has a good chance of being fertile. when feed is in short supply, reproduction is the first activity which is affected. Cows which are permanently undemourished will fail to

reproduce.

19.5 Pregnancy

Cows will usually lose some weight following calving as the nutrient demand to meet milk production increases, this mobilisation of resources is particularly important in high-producing cows, such as Friesian cows. Hence the cow must store body weight reserves before calving; Furthermore in the last weeks of pregnancy calf development shows rapid growth. Therefore during this period the feed requirements of the cow are greatly increased. She should have adequate high quality feed especially during the last two months of pregnancy to meet demands from the growing calf and to increase her own body weight.

19.6 Weight gain

Only when enough feed is available for maintenance and all other needs of an animal, can surplus energy be turned into weight gain. Weight gain is the increase in size of individual muscle fibres (unlike growth which is increased in

number of fibres) caused by storage of surplus energy within them. Fat is also created as an energy store. Both tissues are used for energy by the animals when feed becomes in short supply. when this happens the animal loses weight. In other words it uses nutrients stored in its own tissues to substitute short supplies of feed.

20.0 FEED REQUIREMENTS FOR DAIRY COWS

20.1 Energy

Ruminants need a daily supply of all nutrients required for maintenance and production: milk, meat, growth and pregnancy. Quantitatively any type of nutrient can limit performance levels, but the most likely to be in short supply are energy and protein, this is especially true for high and average yielding cows. Both energy and protein must be considered. For energy, the feeding system uses the metabolisable energy (ME) in the feed as a basis to formulate rations. The ME is the energy remaining in the digested foodstuffs after the loss in faeces, urine, gases and body heat. The basic unit used to measure the energy content is the

Megajoule (N4J).

20.2 Protein

The digestible crude protein (DCP) is widely used to evaluate protein requirements, and it corresponds to the crude protein that remains after losses in the faeces. However, a new system has been introduced which takes into account the degradability of the protein in the ration during digestion. It is a better system to calculate requirement levels, especially for high-yielding cows which have been shown to benefit from protein that escape microbial degradation in the rumen and is absorbed as amino-acids in the small intestine. Following this approach crude protein can be split into Rumen degradable Nitrogen (RDN) and Undegraded Dietary Nitrogen (UDN). Fish meal is for example considered as a good source of UDN.

Inorganic nitrogen sources from plants as well as other non-protein nitrogen, such as urea, are completely degraded by microbes in the rumen. Hence, the RDN is broken down by rumen microbes and used for their protein synthesis by the microbes. Later in the digestion process the microbes are themselves digested and the microbial protein becomes available to the animal Nevertheless this microbial

synthesis is only optimal when the animal receives sufficient energy supplements. Therefore, if sufficient RDP is not available, the rate of digestion of fibrous as well as concentrate rich diets will be reduced. This leads to a reduction in intake, lower energy supply and reduced milk production.

On the other hand, some protein nitrogen can resist microbial breakdown in the rumen and can pass directly to the cows intestine. This feed protein fraction is called by-pass protein which is especially profitable for high-yielding cows. At a low level of productivity a cow can meet her protein requirements entirely from microbial protein and the diet only needs to contain degradable protein. This explains why such a cow can be fed with urea or chicken manure instead of high quality protein can meet the protein requirements. It is therefore important to have the optimum balance of UDP and RDP in the diet. Figure 19 illustrates the increasing requirements for both as milk yield increases.

20.3 Minerals and Vitamins

The major mineral requirements for dairy cows are calcium and phosphorus. The calcium phosphorus ratio is important, and an imbalance can cause infertility. There are reserves of both elements in the skeleton. Pasture is often deficient in

minerals, mainly in phosphorus. In some grazing areas, particularly uplands, dairy cows are subject to a mineral deficiency (especially daring lactation), thus obvious phosphorus deficiency symptoms are frequently observed (probably caused by very acid soil); these symptoms include sore legs, animals will limp, show long hooves and depraved appetite (pica). Seashells and fish meal are good mineral sources. Magnesium is frequently required to prevent hypomagnesaemia on grazing animals. All the required minerals can be successfully incorporated in feed blocks supplements.

Animals feeding on green pasture normally receive all vitamins that are needed. Vitamin supplements are often added to balanced rations prepared as feed to be used in animals housed and reared in intensive systems. Vitamin A is one of the most important vitamins in animal nutrition. This vitamin is found in the carotenoid pigment of green plants; Vitamins D, E and K are also present in green plants.

Figure 19. Protein requirements related to milk yield

20.4 Nutritional Requirements

As mentioned above, nutritional needs of cows depend on age, live weight and production levels. The requirements of ME and DCP for maintenance, milk production, pregnancy and live weight change are supplied in table below:

Table 10. Nutrients requirement of metabolisable energy (ME), in Megajoule(MJ), and crude protein (CP) for maintenance of each cow according to body weight.

BODY WEIGHT KILOGRAM (KG)	ENERGY REQUIREMENTS MJ ME/DAY	PROTEIN REQUIREMENTS KG CP/DAY
300	34.6	0.288
350	38.8	0.324
400	42.9	0.358
450	46.9	0.391
500	50.8	0.423
550	54.5	0.454

Table 11. Metabolisable Energy (ME) and crude protein (CP) for production per Kilogram of milk depending on fat content.

FAT CONTENT (PERCENTAGE)	METABOLISABLE ENERGY (MJ ME/KG OF MILK)	CRUDE PROTEIN (KG/KG OF MILK)
3.4	4.9	0.081
3.6	5.0	0.082
4.0	5.3	0.085

Table 12. Additional Metabolisable Energy (ME) and Crude Protein (CP.) Requirements for Pregnancy and Live weight changes of dairy cows.

1.	**4 - 6 weeks before calving**	
	Additional Metabolisable	**15 - 20 MJ / Day**

	Energy **Additional Crude Protein**	**0.24 - 0.32 Kg CP / Day**
2.	**Allowance for visual assessment by adding**	**5 to 20 MJ per Day**

21.0 BETTER UTILISATION OF LOCALLY AVAILABLE FEED RESOURCES

21.1 What local supplements are available to feed dairy cows, and how to use them?

Good management of improved pasture is the basis of better dairy cow feeding. However, pasture quality and availability varies markedly throughout the season and therefore can hardly meet dairy cow needs at certain times of the year. Dairy cows, if compared to beef cattle, show much higher feed requirements (both in quantity and quality). when grass is in short supply or is of poor quality (low energy and protein contents), body condition is quickly lost, especially among fresh calvers, resulting in a negative long term effect on cow performance:

dramatic decrease in milk production, cows show short lactation and have problems in getting pregnant. Adequate dairy management requires that the farmer should supplement his lactating cows, as this will contribute to an efficient use of grass and so to produce more milk.

A sustainable dairy production system can in many cases be aligned through a better utilisation of locally available feed resources to complement grazing of improved open or shade pastures Leg. under coconut plantations]. There is a wide range of by-products and residues from food crops and food processing which are potentially valuable feed supplements. Their nutritional value and inclusion rate in dairy cow diets are presented in table 13, Some of the most common among this category of foodstuffs are:

1. <u>Copra meal</u>

Copra meal is presently a most abundant potential livestock feed supplement; It is produced

all year around. Copra meal must be stocked in a ventilated place, preventing bad effects from

humidity and avoiding rancidity. It is a good feed resource, particularly rich in protein and in energy feed supplement; it can be included in diets for all categories of livestock diets and it is

specially suited for dairy cattle feeding.

For milking dairy cows, it can be used at fairly high levels: 2-3 kg daily per head. Copra meal is also a good feed supplement for calves and weaners, daily rations of 0,5 to 1,5 kg per head improves significantly live weight gains. However at first animals sometimes are somewhat reluctant to eat this supplement, so copra meal should be introduced progressively into their daily diet to accustom them. As copra meal swells considerably in water, it can be moistened before it is fed in large amounts. It can be fed as sole supplement or mixed with other(s) dietary ingredient(s), such as brewer's spent grain, chopped cassava, banana wastes, cocoa pods, fruit wastes.

2. Spent grains

Brewer's grain or fresh extracted malt is produced as a by-product of brewing beer. Brewer's spent grain is very valuable as a potential supplementary feed for

livestock. It is a safe feed when it is used fresh or properly stored. This is a bulky feed but is a relatively good source of energy and protein. Spent grain is a balanced feed for dairy cows and stimulates milk production. Spent grain can be given in large amounts to dairy cows, up to 15 kg per head daily. A supplement of 8 - 10 kg of wet spent grain is usually adequate to cover the frequent nitrogen deficiency of cows grazing grass only pastures, and can sustain production levels of 4 to 6 litres of milk. Calves can be fed 2 - 4 kg daily. . Wet spent grain spoils rather quickly and should be used fresh or stored in sealed compartments out of contact with air. For longer storage, it may be ensiled in an airtight trench silo, or in tightly tied plastic bag silage. Wet spent grain can be ensiled alone or in association with other feeding ingredients, for example, with 2 -3 % molasses (to ensure proper fermentation), chopped banana by-products (pseudostems, fruit, skin); chopped root vegetables or leaves.

3. <u>Banana by-products</u>:

a: <u>Reject bananas</u>

Reject bananas: both green, mininature and ripe, are a good source of energy supplement to grazing or penned animals. Dairy cows relish them and can be given

in fairly large amounts. But they have a low content of fibre, protein and minerals and should therefore be fed together with grass or source of other roughage (in order to avoid rumen disturbance) as well as with a protein and mineral supplements. Multinutrient feed blocks are an excellent supplement to balance diets that include rejected bananas, because starch and simple sugars in bananas are efficiently used by rumen microbes on account of their access to urea contained in feed blocks. when the reject bananas are widely available, a good silage can be made from chopped bananas mixed with one or several rich-protein feeds, such as poultry litter, spent grain, fish wastes and cassava leaves.

<u>Banana leaves and pseudostems (trunks)</u>:

Bananas pseudostems (trunks) show a great potential in PIC's as a supplementary feed for dairy cows mainly during dry season and will prevent overgrazing of pastures. They can be chopped and fed fresh or ensiled. As pseudostems are low in protein and mineral contents, they are efficiently used when supplemented with rich-protein ingredients, such as copra meal, multinutrient feed blocks, cassava leaves, poultry manure and spent grain.

The use of chopped and ensiled pseudostems is particularly recommended when

the bunch has been harvested and plants are cut down; the large quantity of trunks available at harvest time and can be safely preserved through a well planned silage operation. The silage is of good quality when chopped pseudostems are properly mixed with an easily fermentable carbohydrate (such as molasses, sliced root vegetables) and protein-rich feeds (such as poultry hiler, wet spent grain).

4: <u>Cocoa Pod Husk</u>

Cocoa pods and are suitable feed supplement for dairy cattle. As the pods rot very quickly they must be given fresh to animals; large quantities (up to 8 kg/head/day) can be fed to lactating cattle. Fresh pods are, however, rich in potassium and has a low crude protein content and they must be supplemented with salt and copra meal or other protein feeds. The production of cocoa is seasonal (dry season), so for efficient use and in order to avoid their decomposition, fresh pods must be sun-dried and then chopped, ground and fed to animals or sliced and ensiled in association with aforementioned ingredients.

5. <u>Breadfruit</u>

Fresh, over-ripe and damaged fruits and peelings can be a good energy supplement to be fed to grazing dairy cows and calves. However, the protein content is low and must be supplemented with aforementioned feed resources. The production of breadfruit is seasonal (dry season), thereby for efficient use for off-season feeding, the fruits can be chopped then sun-dried. Sliced breadfruit can be also easily ensiled mixed with other feeds (such as molasses, sliced root vegetables, rejected bananas, poultry litter, wet spent grain

6. <u>Root crops</u>

a: <u>Cassava by-products:</u>

Both the roots and the leaves are valuable feed resources for livestock. Cassava roots are a good energy source for dairy cattle but have low protein content. Fresh and sun-dried cassava roots are consumed by ruminants in different forms (sliced, chopped or finely ground) and used as a substitute for cereal grains in many countries. Cassava roots can be given in fairly large quantities up to 25% of total dry matter intake, but protein and mineral supplements must be fed in order to balance the ration.

Copra meal and multinutritional feed blocks are excellent supplements and have a synergistic effect on cassava roots utilisation. Furthermore, Cassava roots, which contain a very low fibre content, is a good feed for calves which perform very well on it. As cassava roots are rich in easy fermentable carbohydrates, they constitute a excellent energetic additive when they are chopped and ensiled with other feed resources, such as fish waste, cassava leaves, bananas pseudostems, spent grain, poultry litter, etc.

The cassava aerial parts or leaves (1 to 4 tonnes dry matter / ha) are also a potential and valuable protein feed resource for dairy cows in Western Samoa.. They have been successfully fed to cattle in many countries. Dairy cows can easily eat 5 kg chopped leaves per day.

Ensiling is the simplest method to reduce significantly toxic substances (cyanogenic glucosides) concentrations to safe levels. This conservation process also renders cassava leaves more appetising. The silage is fairly balanced for dairy cows when the freshly harvested leaves are chopped and mixed with rich-energy feeds, such as molasses, rejected bananas, root vegetables, wet spent grain.

b: Taro

Taro by-products include roots, trimmings, leaves and vines which are all potentially valuable

feed supplements. Taro roots are out-standing as a feed particularly rich in energy. Raw taro contains sub stalks which irritate the tongue and palate of animals, so that it must be cooked

to improve their nutritional usefulness, mainly for monogastrics. The leaves are rich in protein

content and relished by cattle. Taro by-products can be chopped and ensiled in association with aforementioned feed resources. Silage method reduces considerably undesirable substances in taro by-products which thus become more appetising.

7. <u>Wet pulps from fruit and vegetables (citrus and pineapple pulps and leaves</u>.

Fruit wastes and leaves are some other potential feed resources. The most suitable method for conserving these materials is to ensile them mixed with the aforementioned ingredients, so that they ensure a good fermentation and enhance

the silage quality due to their high sugar content.

The most widespread fruit wastes are pineapple pulps and leaves. The leaves are a good feed for cattle and can be used fresh, sun-dried or ensued. In all case, they must be chopped before use. Dairy cows can be fed daily 15-20 kg of fresh or ensiled plants.

8. By-products from animal and marine origins:

Feed of animal and marine origin are a good source of protein and minerals. They are very important supplements for all type and categories of livestock.

a: Fish by-products:

Fish by-products are an excellent source of protein and minerals for livestock, mainly for cows that have recently calved and for high producing cows. These cows can receive up to 0.5 kg daily of fish meal. This supplement can be produced on a small scale under village conditions using the following procedure: fish or fish waste is chopped, boiled for a short time and squeezed in cloth to eliminate water and oil. The residue is then dried in the sun. It can be finely ground and fed to

animals mixed with other feed supplements. An other alternative to preserve fish wastes as protein-rich supplement is fish silage using molasses.

<u>Seashells and coral</u>:

where there is no mineral source locally produced all seashells and coral are potentially precious mineral supplement for livestock, mainly to meet calcium needs. Oyster shell, sea shell, coral and coral sand. They should be finely ground for cattle feeding but only to a coarse grit for laying hens.

<u>Poultry litter</u>:

Poultry litter can be successfully included in the diet of ruminants as a protein supplement. It is also rich in minerals. Optimum supplement levels for dairy cows is 1 to 2 kg daily. The ensiling of the poultry litter is a simple and appropriate method of conservation which effectively destroys harmful micro-organisms possibly present in poultry litter. A silage made from poultry litter, chopped root crops and bananas by-products provides a balanced diet for dairy cows.

22.0 SILAGE MAKING FROM LOCAL CROP RESIDUES AND BY-PRODUCTS.

22.1 Why make silage?

The problems usually encountered with agro-industrial by-products is seasonality of supply which is often accented by their high moisture content. Hence, they easily spoil creating a nuisance and are often wasted. Ensuing by-products is the most suitable method for their conservation for a long period. The main advantages are:

- Silage can be used strategically for efficient use for off-season feeding.

- It is a means of increasing feed resource availability and a form of insurance for good feeding

management, especially for freshly calved dairy cows.

- It can be efficiently used as a supplement for cattle grazing under coconut plantation.

- It can be stored in a well chosen area close to the farm and provide an excellent and cheap I feed to dairy cows and calves.

- The method improves palatability, significantly reduces toxic substances present in some fresh vegetables and destroy harmful micro-organisms possibly present in poultry litter or fish wastes.

- Silage can also provide a major diet source, and be used as basal ration as well as a feed supplements for grazing animals.

22.2 How to succeed in silage - making?

The ensiled feed supplements should be stored in airtight conditions, preventing contact with air. This will allow foodstuffs preservation and minimise losses in nutrient content. The factors that contribute efficiently to the successful silage are the following:

- Moisture content: ensiled material should contain between 25 and 50 % of moisture. Water can be added to drier feeds to obtain such moisture,

- Length of chop: The finer the chop, the better the silage. Chopping into small pieces can be done by hand or in a stationary forage chopper.

- Presence of enough easily fermentable energy (naturally present or added). For

this reason, protein-rich feeds with low content of energy are very difficult to successfully ensile and should be mixed with easily fermentable energy-rich products, such as molasses, rejected bananas and root crops.

22.3 How to make silage?

Leaves and root crops are finely chopped and sliced (see Photo 26). They are mixed with fine ingredients, such as spent grain and poultry litter (see Photo 27) then properly blended with molasses. when the mix is too dry, molasses is therefore diluted in order to reduce total dry matter content.. The moisture content in the mix can be assessed manually by squeezing strongly a handful of mix. The moisture content is considered satisfactory when liquid trickles, slowly flowing between fingers.

The silage can be stored in stacked layers, packed in succession on the soil which has been beforehand covered with a plastic sheet and banana leaves. This heap, once finished, is then tightly covered with banana leaves and plastic sheets, pressed down by some heavy objects which are placed on its top (see Photos 28, 29). Packed silage in plastic bag that is tightly closed is also an effective storage method. This storage method is easy to handle and has the potential to produce

high quality silage with less waste in a well-sealed bag (see Photo 30). It is ideal for spent grain storage. However, it is not recommended for coarse materials, such as banana trunk and cassava leaves, which can puncture the bag and render the contents useless.

After approximately 6 weeks, the farmer can open the silo and start to feed silage to animals. Silage can be suitably preserved for as long as air is kept away from the ensiled material, it is therefore possible to store airtight silage for 6 months. Once the silo is open, care must be taken to cover the ensiled material after each opening that is made to feed the animals.

22.4 Practical examples of successful silage combinations.

In order to succeed silage making, one should keep in mind that there are different crop residues and by-products and each one has its own specific composition and physical structure:

- Carbohydrate or energy-rich feeds: such as crop roots; spent grain, rejected bananas, and fruit wastes can be successfully ensiled alone.

- Agro-industrial by-products, such as spent grain, which is rich both in energy as well as in protein may be successfully ensiled alone.

- Fibre-rich feeds with low energy and protein contents, such as banana pseudostems should not be ensiled alone..

- Protein-rich feeds with low energy-content , such as cassava leaves, fish wastes and poultry litter should not be ensiled alone. However, in order to ensure adequate preservation, this type of feeds can be successfully ensiled when mixed with one or various energy-rich products such as crop roots, rejected bananas, spent grain and molasses. This silage making is highly recommended because it would provide a balanced diet.

- Incorporation of molasses to silage is optional, nevertheless this is an excellent additive to ensure a good conservation and enhance high silage quality of any ensiled feed resource.

Incorporation rate of the different ingredients to be ensiled are function of (i) available amount of by-products and (ii) animal categories to be fed. For example a high-quality silage, containing increased proportions of energy-rich ingredients

such as spent grain and crop roots, should be prepared for high producing dairy cows. whereas high proportions of cassava leaves and banana pseudostems can be used when there is seasonal feed shortage and therefore when silage would compose the bulk diet, as for instance during off-season feeding. The following associations have been successfully ensiled during on-farm demonstrations carried out in

Samoa:

Table 14. High quality silage making

Ingredients (for 100 kg dry matter basis)	Kg	Equal to Kg fresh matter basis (or Kg fresh ingredients per mix)
Cassava leaves	15	100
Chopped crop roots (Cassava roots)	25	100
Chopped banana	10	70

Chopped banana pseudostems	10	70
Spent grain	30	150
Poultry litter	10	15
Molasses	10	15
Total	100	450

Table 15. Medium quality silage

Ingredients (for 100 kg dry matter basis)	Kg	Equal to Kg fresh matter basis (or Kg fresh ingredients per mix)
Cassava leaves	25	150
Chopped crop roots (Cassava roots)	15	60
Chopped banana	20	150

pseudostems		
Spent grain	15	75
Poultry litter	20	25
Molasses	5	7
Total	100	467

23.0 MANUFACTURE AND UTILISATION OF MULTINUTRITIONAL FEED BLOCKS (MB).

23.1 What are feed blocks and their main effects on animals ?

Feed blocks are a feed supplement which can enhance efficient utilisation of native and improved pastures. Their main effect on animals is to increase appetite and intake of poor-quality forages and pastures which boosts animal performance and consequently improves productivity. The solid mixture contains urea (10%), salt (10%) and local by-products incorporated into a block structure that is licked by animals.

23.2 What are the ingredients in the formula of blocks?

whatever the applied formula, the common ingredients in feed block are:

- ***urea, the "strategic" ingredient,***
- ***fibrous feed ingredient,***
- ***minerals,***
- ***molasses (Optional)***
- ***bonding agents.***

Table 16. Two satisfactory formulas which can be successfully applied in PIC's:

Ingredient	Formula 1 (kg per 100)	Formula 2 (kg per 100)
Copra meal	45	60
Molasses	20	0
Cement	15	20

Urea	**10**	**10**
Salt	**10**	**10**
TOTAL	**100**	**100**
Water	**25**	**40**

23.3 How to make feed blocks?

The manufacture technique is simple, and easily accessible to small farmers. The equipment required is very simple and relatively cheap. Mixing may be done by hand, in a concrete mixer or in a horizontal barrel mixer. Whatever the applied formula, the steps for making the blocks remain the same. These steps consist of: weighing, mixing, moulding and drying. Small (10 to 20 kg) or large (50 to 100 kg) quantities can be prepared in each batch

The procedure presented hereafter is concerning uses Formula I [see above]. Steps

for making up the mixture (100 kg) are:

23.3.1 Mixing

(i) Urea (10 kg) is mixed with salt (10 kg) in a large container. A solution is made up

using 25 litres of water. Avoid urea lumps as this could lead to animals being poisoned due to an overdose. Then add molasses (20 kg) and stir the mixture well with a wooden stick for five to ten minutes (see Photo 31.)

(ii) The specified amount of copra meal (45 kg) is placed on the ground in a round heap on a hard and even concrete drying floor. Then add to it the amount of cement (15 kg). The mix of copra meal-cement is thoroughly mixed using shovels and/or forks (see Photos 32 and 33). For preparation of small amounts (10 kg) the mixture can be

prepared by hand in a large plastic bowl (see photo 34.)

(iii) when the mix of copra meal-cement is carefully mixed, form a hole in the middle of the heap and gradually sprinkle by hand or using water sprinkler the mixed solution of "molasses-salt-urea" and carefully knead until a uniform paste of good consistency has been prepared (balls should not disintegrate when moulded in the hands). If these balls tend to crumble, then one should add a little more water (3 or 5 litres) and continue mixing (see Photo 35.).

23.3.2 Moulding

Once the mixture has been properly kneaded, small amounts are progressively stacked into separate moulds. The cubic mould type (20 x 20 x 20 cm) consists of four flat pieces of wood in which slots have been made so that they can be easily assembled to form the mould and then

later dismantled when the brick is removed (see Photo 36.)

The mixture is then strongly compacted in the mould using a heavy wooden or metal pounding rod (see Photo 37.). Simpler motilds can also be used, such as half buckets, cans cut to size or any other receptacle which is locally available. Taking the bricks out the motilds may be eased if they are lined to start with, using plastic sheet

23.3.3 Drying

(i) Once the mixture has been well compacted, the blocks are carefully taken out of the moulds and arranged on a drying floor (see Photo 38.), preferably in the shade as the strong sun can cause cracking in the blocks. The blocks will dry and be ready for use after about 10 days. Blocks weighing 8.5 to 10 kg when dried can be made with this type of mould.

The blocks should be sufficiently resistant for transport and hard enough to withstand licking without crumbling (if too friable large chunks could be munched by animals thus increasing the risk of urea toxicity).

If blocks are not hard enough or are friable, this could be due to:

-errors in the quantities of the ingredients (probably insufficient water)

insufficient uniformity in preparing the mix, mainly pellet forming from wet copra meal

insufficient packing down of the mix into the mould, poor quality bonding material: cement which is too old, poor solutions with only part of certain ingredients being dissolved (urea, salt,...)

If friability persists despite all these precautions, increase the amount of the bonding agent. On the contrary, if blocks are too hard the amount of cement can be reduced to I 0% instead I 5%. when the quantity of the cement is increased or decreased, incorporation rate of copra meal must also be modified.

Once dried the blocks can be stored in a dry place for several months up to year. Their quality varies very little.

23.4 How to use feed blocks?

Blocks constitute a feed supplement that improves utilisation of poor quality-forage and unbalanced grasses. How to use these blocks depends upon the feeding system. If the animals graze pasture, the farmer can leave the blocks available to them in a sheltered trough (see Photo 39). when animals remain in confinement (animals being milked or fattened) and are fed with silage and cut grasses, the farmer can leave the blocks available at all times in feed box.

Finally one should always recall that blocks contain urea which can be toxic if consumed in excess of the normal dose; it is therefore recommended to respect the following precautions:

> ***a. Only give the blocks to ruminants because only ruminants are able to take advantage of the urea in the blocks. The blocks should be not given to pigs, equines, chicken. Calves can have access to blocks after the age of 2-3 months. Wet blocks (due to rainfall) become very soft and can easily cause intoxication due to urea high intake. Consequently blocks should be always kept under shelter and far from water trough***

b. Blocks should be used as a supplement and not as the basic ration. Feedblocks are catalytic" supplements which allow ruminants to take better advantage of native and improved grasses or protein-poor by-products (from bananas, crop roots....). But they should not be used to replace them.

A minimum of coarse forage in the rumen is essential. Therefore, the farmer should not give the blocks to an animal with an empty belly as one risks causing feed poisoning due to an excessive consumption of urea.

c. when first introducing blocks it is advisable to respect a transition period. Offer blocks progressively over a period of two weeks so that the animal becomes adapted to this new supplement which contains urea. when animals are reluctant, the farmer can put some copra meal or other appetising product, such as molasses, salt or chopped grassed on top of the block to help the animal become accustomed to it. Once the animals are adapted to the supplement, they will regulate their intake on their own and the blocks can be left available all the time.

d. The feed block intake per head varies between 250 to 400 g I day for

adult cattle when intake is lower or higher, the farmer may check the hardness of blocks. This can be corrected

by modifying the proportion of bonding agent in the formula: add more to increase hardness or

reduce it to make the block softer.

e. Finally availability of the blocks should be regular and continuous so as to avoid having to undergo another adaptation period for the animal, which in fact will take another two weeks each time distribution of these blocks has been discontinued.

24.0 THE ECONOMIC AND NUTRITIONAL BENEFITS OF FEED BLOCKS, AS COMPARED TO MULTIMINERAL SALT BLOCKS

24.1 Feed blocks are simple to make locally and at low-cost:

The cost of feedblocks, considering formula F I which was successfully tested in

Samoa [1997] and taking account cost of ingredients plus those for manufacturing the blocks, is as follows:

Table 17. Cost of feed blocks in Western Samoa block (1 US$ Dollar = 2.5 W$T, September 1997).

ts	Composition per 100 kg of mixture	Price per kg (WST$/kg) Sept, 1997	Contribution to total cost (WST$)
al	45	0.15	6.8
s	20	0.20	4
:	15	0.64	9.6
	10	2.00	20
	10	0.60	6
	100		46.4

(i) Feed blocks cost only 0.464 WST$ per Kg

(ii) The mixture of 10 kg to produce one strongly compacted block using the wood made cubic mould (20 x 20 x 20 cm) cost 4.46 WST$ per 10 kg of blocks. With a daily average intake of 350 g per cow -one block is sufficient to feed a cow for approximately one month-therefore the cost of daily supplementation is 0.162 WST$. This is equivalent to 0.065 litres of milk (at 2.5 WST$/litre).

(iii) Imported multimineral salt blocks are very expensive when compared to feed blocks; sale price is

2.75 WST$/ kg (49.5 WST$ I Block of I 8 kg of salt block), which is 6 times the cost of feed block production based on the ingredient's price.

24.2 Feed blocks are more advantageously nutritional than salt blocks:

The effectiveness of blocks for dairy business is much higher than imported multimineral salt blocks.

Salt blocks are composed of salts (80% is common slat, sodium chloride).

whereas feed blocks are a source of nitrogen, energy and minerals, aiming to ensure intake increase and efficiency of digestive utilisation of pasture and poor quality-forage.

25.0 SOME PRACTICAL ASPECTS OF FEEDING DAIRY COWS

25.1 Which are the Priorities for Feeding Dairy Cattle?

Different categories of animals have different feed requirements. It is difficult to meet these different demands in practice when all animals are running together. Furthermore it is important to avoid wasting feed when it is in short supply and when some foodstuff is not essential for certain groups . Preferential feeding of stock may be possible however when fodder is fed from a store, or if it is cut and carried (green pasture), or silage/supplementary feeding to grazing cattle. The categories of dairy livestock that should be ranked with high priority in preferential feeding practices are:

25.1.1 Newly calved cows:

This category of stock must enjoy first priority in preferential feeding using high-quality ration:

grasses of high digestibility and feed value and I or good quality-silage , both supplemented with rich-value feeds such as copra meal and spent grain. The milking cow is in energy deficit during early lactation because their appetite is lowest at calving and it only increases to a peak around the fourth month of lactation. This deficit is compensated by large mobilisation or loss of the body fat during the first two months after calving. figure 20. demonstrates the relationship between milk yield, body weight change and appetite for a high-producing cow.

The dairy farmer has to recall that this obligatory mobilisation in the beginning of lactation is closely associated with the dairy genetic potential of the cow, and is therefore very high in animals such as Friesian cows. Consequently, if feed is in short supply when fresh calved, the body condition of these cows can be lost dramatically resulting in long term negative effects on cow performance: delayed conception after mating, decrease in milk production and short lactation. This phenomenon is frequently observed where beef cows are clearly in good condition

as compared to skinny Friesian cows in early lactation period.

In conclusion, the dairy farmer must ensure good feeding levels of his cows in early lactation

combined with good body condition at calving (this implies also good feeding in late lactation)

play a key role on overall milk production. These management practices facilitate higher peak yield in early lactation and a higher total lactation yield is achieved as well. The peak yield is

critical, because for each litre obtained at peak the overall lactation increases by 150 litres.

Figure 20. Relationship between milk yield appetite and liveweight

25.1.2 The calf:

The calf should begin eating grass as early as possible after being born, but it needs high quality easily digestible forage and protein rich supplement, for growth and development.

25.1.3 Growing Dairy Females - Heifers:

This is the second most important group of cattle concerning ranking priority for preferential feeding. If underfed when young, they will not reach full body development and expected liveweight at maturity and their breeding performance may be negatively affected for life. They should be well fed in order to increase weight by quick body growth that can enable them to produce their first calf at an early age. Friesian heifers must reach 350 - 380 kg live weight at 16 - 18 months and should be mated at that age bracket for their first calving to take place at 25 - 27 months.

25.1.4 Pregnant cows:

This is the third most important dairy cattle group when ranking feeding priority. As indicated above, cows will usually lose some weight following calving as their milk production increases and appetite is low. Hence they need to have body

reserves at calving to meet resource mobilisation during early lactation, The rapid calf growth in the last weeks of pregnancy development is also another very important period in pregnant cows. She should receive relatively high quality fodder especially during the last two months of pregnancy to meet requirements of the growing calf and to increase her own body reserves.

25.2 How can Farmers Formulate rations for their own dairy cows?

The cost of producing milk is closely linked to feeding costs. In order to reduce the cost of feed and produce cheaper milk, dairy production must utilise larger amounts of cheaper feed but of good quality such as well managed grass-legume pastures, supplemented with locally available feed ingredients. In order to benefit from the dairy potential of cows, the farmer should take the following steps in formulating a dairy diet:

(i) First, identify local feed resources based on their nutrient characteristics or composition. For example, energy, protein and determine appropriate levels of inclusion in the diet. This information could be obtained from text books (literature values), from the laboratory (chemical analysis) or the values indicated in Table 13, presented in Section 21.

(ii) Secondly, determine the nutritional needs of cows, based on age, live weight and production. Those information could be obtained from text books or the tables 10, II, 12 in earlier sections of this book.

(iii) Thirdly, formulate the ration which would be composed from a basal diet (may be pasture and I or silage) and feed supplements by balancing nutrient supply to cow needs.

Let us take an example of how to calculate a ration for dairy cows grazing Batiki Bluegrass under coconut plantation. Proceed as follows:

a. <u>The data required are as follows</u>:

- Weight of cow e.g. 500 Kg

- Milk yield per day e.g. 10kg

- Butterfat content e.g. 4.0 %

Table 18

Live Weight (Kg)	Metabolisable Energy (MJ ME)	Crude Protein (CP): Kg/day
500	50.8	0.423

c.To calculate the MJ ME and Kg CP. necessary for <u>production</u> of milk.

-It is found that for this cow - with 4.0 % milk fat content- MJ ME is 5.3 and Kg CP. per kg milk is 0.085.

-Multiplied by the quantity of milk produced per day the following requirements are estimated:

ME: 10kg milk / day X 5.3 MJ 1Kg = 53.0 MJ I day

CP: 10 kg milk I day X 0.085 Kg/Kg = 0.85 Kg I day

d. To add needs for <u>live weight loss.</u>

- Allowance for visual assessment must be made for skinny and bad looking

animals by adding 5 to 20 MJ ME per day according to results of visual assessment ranking. (see Figure 17.)

- For the purpose of this example 10 MJ and 0.16 Kg CP are accounted.

e. The total ME and CP required is estimated by adding up all figures, which have been calculated.

Table 19.

equirement	Metabolisable energy (MJ ME)	Crude Protein (CP): kg/day
enance	50.8	0.423
uction	53.0	0.85
ssessment	10.0	0.160
otal	113.8	1.433

f. To estimate probable total dry matter intake

(DM):

- Total dry matter intake depends on the live weight of the animal, its level of milk production, its stage of lactation and quality of diet.

- As a rule of thumb DM intake is 2.5 to 3.0 kg per 100 kg of body weight for milking dairy cows and 1.5 to 2 kg for dry cows. For the purpose in this example 2.7% is used

e.g. Cow Weight = 500 Kg, DM intake= 13.5kg/day

- If the DM intake is 13.5 kg I day, therefore the necessary energy content per kg DM in total ration (ME) must be 8.5 MJ so as to meet the cow requirements. The result is obtained as follows:

Total energy requirement divided by total dry matter intake, e.g.

113.8 MJ ME divided by 13.5 Kg DM /day 8.5 MJ ME/Kg DM.

This would be very difficult to reach.

g. Nutrient Supply from Batiki Bluegrass

- Our problem cow obtains its nutrients from the daily ration that is eaten. It is necessary therefore to know the composition of feeds and their intake. The former can be obtained from table whereas it is often difficult to estimate feed intake from pasture.

- Let us assume this cow while grazing pasture can achieve a 50 kg daily intake of fresh vegetative Batiki grass and without any supplement. The supply of nutrients from this foodstuff and the amount of milk that can be produced with such ration are:

Table 20.

	A	B	C	D	AxB	
Feed stuff	Weight kg/day	Dry matter (DM) content (%)	Energy content MJ ME per kg DM	Protein content kg CP per kg DM	DM intake kg DM/day	

Fresh vegetative Batiki grass	50	0.20	6.5	0.080	10.0	
Total supply	50				10.0	
Requirements		Maintenance		(500 kg)		
Balance	for	Production		(Milk)		
Amount of	Milk that can	Be produced	(5.3 MJ and	0.085 kg CP	Per kg milk)	
Feed	supply	Must	provide			

- Calculate the daily quantity of DM from the feed by multiplying AxB.

- Multiply this answer by C to get the ME supplied by the feed.

- Do the same for CP. Multiply the DM supplied by the feed per day (A x B

) with D

to get the quantity of CP fed daily.

- The ME from the feed ration meets the requirements for maintenance and 2 7 kg of

milk (14.2 MJ/kg/5.3 MJ/kg) and the CP fed is enough for maintenance and 4.4

kg of milk (0.377 kg CP/0.085 Kg CP).

- Calculate the feed supply: Total requirements - batiki grass Ration supply:

113,8 MJ 65.0 MJ = 48.3 MJ and 1.433 kg CP - 0.800kg CP = 0.633kg CP.

In conclusion, it is evident from this example that grass within this such value is insufficient to meet the milk potential of the above cow and therefore feed supplements must be added. In this case distribution of copra meal (2 kg) and spent grain (10 kg) or Silage A (15 kg of high-quality silage, see Section 22) may easily cover the deficit and provide a balance between feeding level and animal

requirements.

25.3 Some Practical Examples of Dairy Cow Rations

It is difficult to control the grazing intake of milking cows under grazing conditions where quality of native and improved grasses varies markedly throughout the season. However, the intake of animals can be controlled when they are penned or tethered and the fodder is carried to them.

Therefore farmers should practice a cut-and-carry feeding system, to supplement the grazing intake of high-producing cows and especially those newly calved. A recommended practice is to grow a block of hybrid elephant grass Penisetum purpureum, which is considered a highly productive perennial grass [with good dry season performance] and suitable to cut-and-carry systems. Also local types of elephant grass, guinea grass, Guatemala grass, leucaena and some wild shrub legume varieties such as Adananthera sp, and Albizia sps. are well suited to cut and carry. More information on cut and carry systems can be found elsewhere in this book.

In all cases of feeding systems: grazing or cut-and-carry green forage, farmer

should strive to gain skill in assessing grass quality so that the amounts of feed supplements may be estimated.

Some suitable rations are hereafter presented where basal diet is fresh grass grazed or cut and fed to penned cows. We draw the attention of farmers that the former are presented as a mere approximation, because the quality of the sown and wild grasses can vary dramatically. For further details farmers should request information from the Livestock Advisory Service.

25.3.1 For growing heifers to reach breeding age as quickly as possible (16 to 18 months.)

- grazing pasture under coconut plantations

- free access to feed blocks

- 0.5 kg of copra meal

- 5 to 10 kg of silage B (Medium-quality silage making, see Section 22)

Note: the last feed supplement [silage] can be given from 15 months.

25.3.2 Dry Cows and Pregnant Cows up to 7 months

- grazing improved pasture under coconut plantations

- free access to feed blocks

Note: if there is grass shortage due to overgrazing or dry season, these cows can receive 15 kg of silage B (B (Medium-quality silage making, see Section 22)

25.3.3 Cows in the last two months of pregnancy:

- grazing improved pasture under coconut plantations

- Free access to feed blocks

- 1 to 2 kg of copra meal (depending on body condition)

- 5 to 10 kg of silage A (High-quality silage making, see Section 22) (depending on body condition)

Note: (i) if there is a pasture shortage due to overgrazing or dry season, the cow should be fed 15 to 20 kg silage and I to 2 kg of copra meal, depending on body condition;

(ii) Two weeks before calving the cow should be fed the same type of ration that she would receive at and after calving period but in reduced quantity, so as to adapt its stomach to the new diet.

25.3.4 Lactating Dairy Cows:

Case 1: Basal diet while grazing improved pasture under coconut plantations:

Milk Yield per day (kg)

5 10 15 20 25

Feed Supplements

per day (fresh kg)

Copra meal 1 2 3 3 3

Spent grain 5 10 15

Silage A (30% DM) 10-15 15-20 20-25 20-25

Note: (i) Cows can have free access to feed blocks;

(ii) Cows eating more than 10 kg spent grain and 20 kg of silage A, should have enough fibrous materials, for example some dried wild grasses;

(iii) Quantities of spent grain and silage A can be reduced if improved pasture is

young, and of good quality;

(iv) In order to give newly calved cows maximum opportunity to express their dairy potential, those cows should be not be fed according to their milk yield, due to their lowest appetite they must receive in addition to unrestricted grazing 15 kg spent grain and 25 kg silage A and 3 kg of copra meal. when there is refusal of feed, left-overs can be fed to other cows.

Case 2: Basal diet is chopped Elephant grass (cut-and-carry system). Milk Yield per day (kg)

---

5 10 15 20 25

Feed stuffs

per day (fresh kg)

Chopped Elephant grass 40 40 40 50 50

Copra meal 1 2 3 3 3

Spent grain

Silage A (30%DM) 10 15 25 25

Note: (i) Cows can have free access to feed blocks,

(ii) In order to give newly calved cows maximum opportunity to express their dairy

potential, those cows should be not fed according to their milk yield, due to their low [depressed] appetite they must receive freely the following ration: good quality mixed fresh green grass (40 to 50kg) and silage A (20 to 30kg), 3 kg of copra meal and 10 to 15 kg spent grain. whenever feed is refused or left-over it should be fed to other cows.

25.4 Are there other points to be outlined on dairy cow

feeding?

25.4.1 Be careful with changes in feed quality and type:

Ruminant animals develop micro-organisms in the rumen to break down the complex organic compounds of plant materials to simpler substances. Different micro-organisms are needed for different plant materials. Hence, changes in diet of animals should be made gradually as far as possible to allow the mixture of rumen micro-organisms populations to change in composition and thus be able to cope efficiently with changes in the diet. This re-organisation takes time.

Avoid sudden changes to the diet. The micro-organisms are seriously affected, especially if silage and spent grain or other energy rich supplements are abruptly increased. Arrange for a change of diet to take place gradually over two weeks at least.

25.4.2 Avoid over-feeding at one meal:

Avoid feeding large amounts of feed supplements in one meal, Silage A, spent grain, copra

meal and other rich-energy supplements, are fed each day in large amounts, especially to high-yielding cows; these amounts should be evenly spread at regular feeding times. This practice must be observed especially during weekends Remember that dairy cows are creatures of habit and that their digestive system works more effectively if a regular feeding pattern is maintained.

25.4.3 Regular adjustment of feeding plan:

The rate of decline of milk yield, as well as the body condition of the animal, should be regularly monitored and adjustments introduced to feeding norm. Otherwise over-feeding would lead to excessive fattening instead milk production.

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25.2 How can Farmers Formulate Rations for Their Own Dairy Cows?

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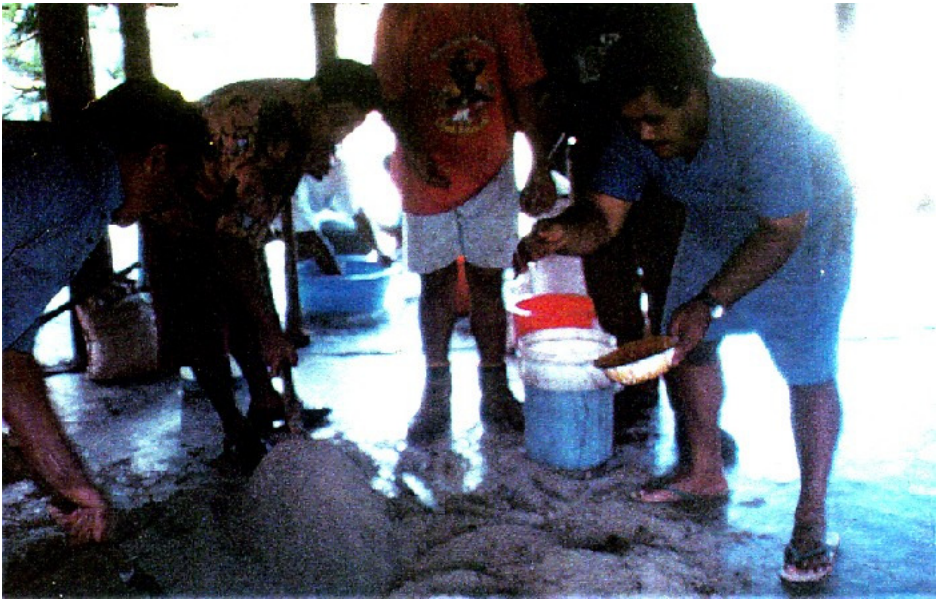
Photo 31. Making feed blocks mixing the urea, molasses and water.

Picture 32. Copra meal is placed on the floor.

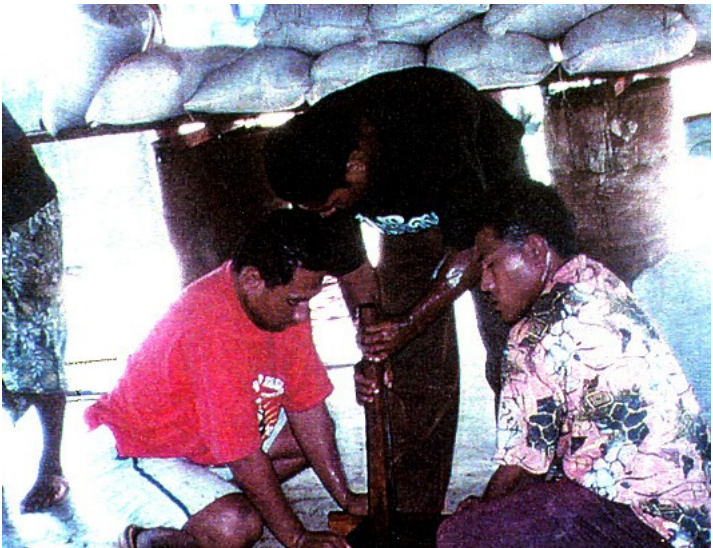
Picture 33. Copra and cement are mixed well.

Picture 34. Small amounts can be prepared in a bowl.



Picture 35. The molasses-salt-urea solution is sprinkled and mixed into the copra meal and cement.

Picture 36. The mould is made of four pieces of wood with slots, these enable the boards to interlock.



Picture 37. The mixture is compacted using a pounding rod.

Picture 38. The well compacted blocks are dried in the shade.

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