DỰ ÁN BÒ SỮA VIỆT BỈ
VIETNAM BELGIUM DAIRY PROJECT

Practical manual for small scale dairy farmers in Vietnam

NUTRITION AND FEEDING MANAGEMENT IN DAIRY CATTLE

Second edition

Hanoi 2009

Composed and Published by

DỰ ÁN BÒ SỮA VIỆT BỈ
VIETNAM BELGIUM DAIRY PROJECT

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Forewords

The Vietnam Belgium Dairy Project (VBDP) aims to increase the income of the rural population by sustainable growth of the domestic milk production in Vietnam. The project is implemented from 2005-2009 by the Ministry of Agriculture and Rural Development (MARD) with technical assistance of the Belgian Technical Cooperation (BTC).

Comprehensive training of farmers is one of the main activities of the project. The project has chosen for a Training of Trainer system (TOT) in which leading demonstration farmers and/or technicians are trained to become a trainer of a group of dairy farmers. This booklet on Nutrition and Feeding is a part of a series of booklets that cover the different aspects of Good Dairy Farming Practice. Each booklet is accompanied by flipcharts that can be used during training sessions. All manuals and flipcharts can be downloaded from the Dairy Vietnam website: www.dairyvietnam.org.vn

Although some knowledge and concepts might be unfamiliar to some dairy farmer in Vietnam, the authors made very short and simple expressions which are accompanied by animated and easy to understand images and pictures to intrigue readers and most importantly to convince farmers to follow the instructions in the manual.

We would like to thank all persons who contributed to the completion of this second edition. Special thanks go to Dr. Nguyen Xuan Trach and Dr. Dinh Van Cai.

On this occasion, we would also like to express our gratitude and appreciation to the farmers and technicians who follow the guidelines of the manuals and who teach other farmers by using our publications. Sincere thanks!

Constructive feedback on any of our publication is always welcome!

DỰ ÁN BÒ SỮA VIỆT BỈ
VIETNAM BELGIUM DAIRY PROJECT

Dairy Vietnam
Ngành sữa Việt Nam

BỘ NÔNG NGHIỆP
VÀ PHÁT TRIỂN NÔNG THÔN

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Chapter 1:

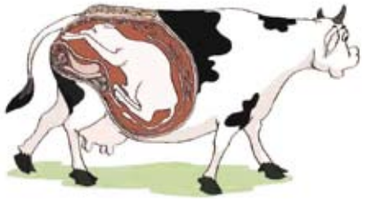
THE BASICS OF RUMINANT NUTRITION, DIGESTION AND FEEDING

1. Nutrient requirements

Why does a cow need to eat?

- to stay alive (=maintenance)

- to grow
- to grow a fetus



- to produce milk

Note: Requirement for maintenance depends on body weight of the cows

2. Dairy nutrients

Dairy feed needs to provide

Energy: It is as the fuel for a machine and it is needed for milk production

Protein: The material to build up the muscles, fetus and the milk production

Minerals: They are needed for growth of the bone and the fetus as well as for the milk production

Vitamins: Intervene in the metabolism and the digestion of feeds

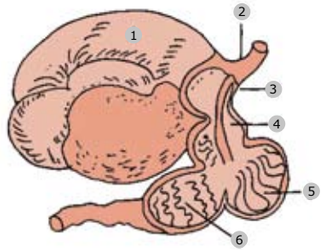
Water: Water is needed for maintenance and to produce milk. Water contains about 90% in the milk

3. Digestion

3.1. Anatomy and function

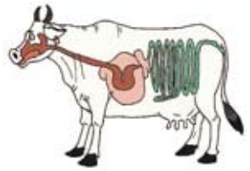
Cows are ruminants with specialized digestive tracts:

Mouth: consumes the feed, chewing, secretes saliva



Stomachs: Consists of 4 stomachs: rumen, reticulum, omasum and abomasum

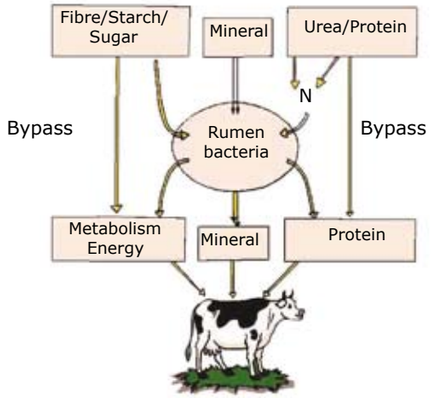
- The rumen and the reticulum are big fermentation buckets which contains numerous of bacteria to degrade fibre
- The omasum absorbs and filters the nutrients
- The abomasum digests nutrients by enzymes as the monogastric

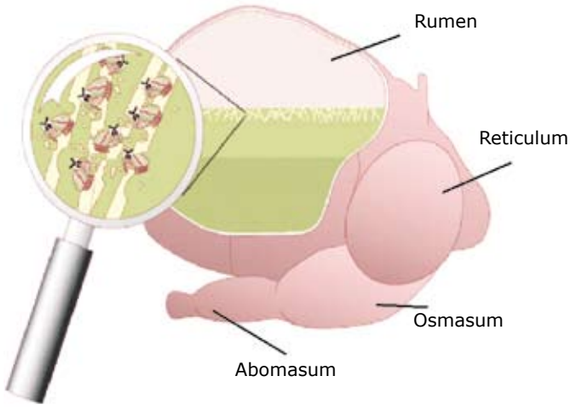


Intestines digest and absorb nutrients

3.2. The rumen bacteria

- Feed is digested by bacteria before it goes to the other stomachs and the intestines.
- Bacteria use the nutrients in the feed to produce nutrient for the cow (energy, protein).
- Bacteria can also use Non-Protein Nitrogen (urea) to produce protein for the cow.



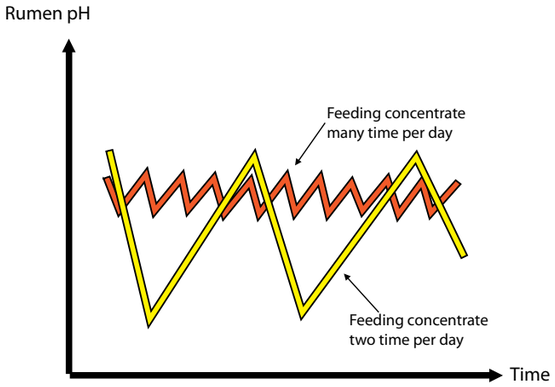


So feeding a cow, actually means feeding the bacteria!

Bacteria work best in a stable rumen environment

It is important to keep the rumen environment stable (stable pH) by:

- Providing energy, protein and fiber **regularly** and continuously: forages should be always available. Concentrate should be provided at least 3 times per 24h.



- **Feed is not changed rapidly.** Every change in feed should be introduced gradually.

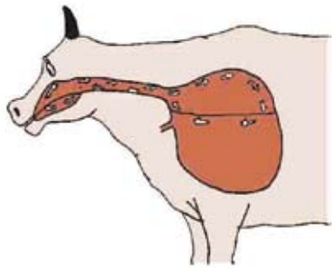
- There is always a **good balance** between forages and concentrate. If too many concentrate is provided, the rumen becomes too acid (=low pH) for the bacteria.

3.3. Rumination

Rumination is the process of bringing feed back up from the rumen to the mouth.

- More saliva is produced
- Bacteria from the rumen and feed are mixed
- Feed is more readily digested by rumen microbes as particle size is reduced

A cow may spend as much as 35 to 40 % of each day ruminating (cud chewing)



Cows need to ruminate!

Cows lay down to ruminate!

Note: Saliva is the major buffer for helping to maintain a rumen pH between 6.2 and 6.8 for optimum digestion of forages and feedstuffs

4. Components of dairy feed

We divide the components of dairy feed in:

Water

Forages

Concentrates

By-products

Minerals

Vitamins

4.1. Water

Water is the nutrient required in the largest amount by dairy cattle

Cows need water

- for normal body functions
- to produce milk
- to produce urine
- to evaporate

Note: Milk contains about 90% water!

The amount of water needed depends on:

- the body weight
- the milk production
- the temperature
- the feeds and the diet

I am thirsty!
The lack of water will directly result in reduced milk production!

Chapter 1: The basis of ruminant nutrition, digestion and feeding

Examples:

Dry cow	:	40 -60 liter per day
10 kg milk/day	:	40 -60 liter per day
15 kg milk/day	:	60 -80 liter per day
20 kg milk/day	:	80 -100 liter per day
30 kg milk/day	:	100 -140 liter per day
40 kg milk/day	:	120 -180 liter per day

Water supply: Cows get water

From feed

Fresh forage: 70 -90% water

Dried forage (hay): 12-15% water

From drinking

The requirements for water supply are:

1. Always AVAILABLE: easy access at all times everywhere in the barn
2. CLEAN: no residue of feed, faeces etc.
3. TASTY : fresh, no strange smell
4. SAFE: no pathogens, pesticides, poison etc.

Water trough

Water troughs should be based on the criteria above. Good examples are:

Automatic water trough La Buvette

Locally made

Large drinking trough which are easy to clean

Automatic drinking system

Cows drink a lot right after milking. Make sure that they have immediate access to water after milking!

4.2. Forages

Cows need forages

- for good rumination
- to get structure in the rumen
- for good rumen digestion

Forages need to supply:

- sufficient fiber for good digestion and rumination.
- an important part of the required Energy, Protein and Minerals

Forages can be used in grazing and cut and carry methods:

Grazing: the feeds are selected by cow in the field and voluntary feed intake is normally lower than cut - carry system

Cut - carry: higher feed intake results higher in milk production

Forages can be used:

Fresh

Dried

Chopped

As silage

How to evaluate forages?

Consider quality

The nutrient content of forages can vary greatly.

Even though many forages look similar, there are important difference between them!

The following factors should be taken into account:

1. Feed intake
2. Dry matter content
3. Protein and Energy content
4. Fiber content

Consider quantity: How much forage can we produce?

Quality?

1. Feed intake

Cows need to eat as much forages as possible: Higher quality forages result in a higher feed intake!

Quality of grass	DM intake (% body weight)
Excellent	3,0
Very good	2,5
Good	2,0
Medium	1,5
Bad	1,0

To evaluate feed intake: observe or ask your cow!

Good questions to consider:

Does my cow like to eat this forage?

Does my cow eat all parts of this forage?

Does she eat this part I give her?

Does she eats it quickly or only because she is really hungry?

LEAVES versus STEM ratio

Most nutrients concentrate in the leaves. That is why grasses such as Guinea, Mulato and Australian Mix have higher quality and feed intake comparing with Elephant grass and VA 06.

Forages with a lot of stems result in a lower feed intake

10 kg Elephant grass = 7 kg stem + 3 kg leaves

Grasses	Stem/leaves ratio	Edible Fraction (%)
Elephant grass	70/30	60
VA 06	75/25	60
Guinea grass TD58	15/85	95
Mulato 2	15/85	95
Australian mix	25/75	95
Para grass	40/60	85
Avena grass	25/75	95

Source: Data from Vietnam Belgium Dairy project 2009

How to increase feed intake?

By chopping into small particles

By providing the forage 24/24

By drying in the sun

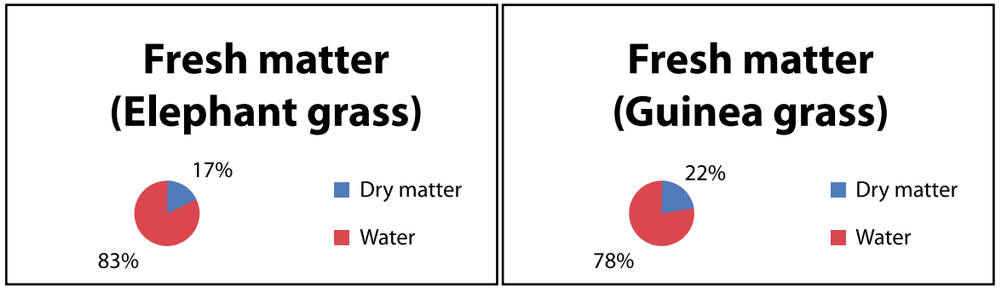
By mixing several forages

By reducing heat stress…

- *Feed intake can be very different from quantity of production: A good example is Elephant grass: Yes, you can grow a lot of it, but how much did your cow really eat?*
- *Add new feed regularly!*

2. Dry matter content

Fresh matter = dry matter + water



3. Protein and Energy

Protein and Energy are essential for maintenance, growth, and milk production.

Protein and Energy are inside the Dry Matter (DM) and are usually expressed as:

Protein : crude protein (CP) % of DM

Energy : MJ/kg DM

Some forages have more Protein and Energy inside the dry matter than others.

Forage	DM (%)	CP (%)	ME (MJ)
Elephant grass	14-17 %	6-9 %	7-8 MJ
VA 06	14–18 %	7-9 %	7-8 MJ
Para grass	17-24 %	10-13 %	7-8 MJ
Guinea	19-27 %	10-14 %	8-9 MJ
Mulato 2	18-22 %	11-15 %	8-9 MJ
Avena Sativa	14-19 %	15-18 %	7-9 MJ
Australian mix	14-22 %	12-17 %	7-9 MJ
Corn forage	18-29 %	9-14 %	7-9 MJ
Whole corn include cob	22-28 %	8-11 %	9-11 MJ

4. Fiber

The rumen needs sufficient fiber (structure) to function well.

However, too much fiber will slow down the digestion. For a good digestion and rumination, the fiber content should be at least 28 % of the DM (NRC, 2001)

- *OLD grasses have MORE FIBER than young grasses!*
- *STEM have MORE FIBER than leaves!*

VERY IMPORTANT NOTE:

Protein and energy content can vary a lot depending factor such as species, soil fertilizer, climate, seasonal, harvest stage etc.

So you should use data in the above table only as indicative value.

Important is to understand what DM, CP and energy means and to react on signals of your cow. These signals include: feed intake, feed refusal, changes in milk production and body condition score etc.

Quantity

A cow needs a lot of forages every day. So we have to consider how much we can produce.

The production depends a lot on the quatily of the soil and the management (irrigation, fertilization...).

The table below gives an overview of average data:

Grass	Number of cutting	Fresh biomass (ton/ha)	DM content (%)	DM yield (ton/ha)	CP yield (ton/ha)
Elephant grass	7	250	16%	40	2.8
VA06	7	300	16%	48	3.6
Guinea TD58	9	150	22%	33	3.96
Mulato 2	9	200	19%	38	4.9
Australian mix	9	250	17%	42.5	5.7
Para grass	9	120	19%	22.8	2.74
Avena	3	60	15%	9.0	1.62
Corn forage	1	60	21%	12.6	1.51
Whole corn	1	60	27%	16.2	1.54

Source: From Vietnam Belgium Dairy Project 2009

- Fresh biomass = kg/m2/cut * number of cut * 10000
- DM yield (ton/ha) = Fresh biomass (ton/ha) * DM content (%)
- CP yield (ton/ha) = DM yield (ton/ha) * Cp content (%)

Good grass contains high CP, ME contents and has a high palatability! The grass has

- High percentage of leaves, low percentage of stem
- Soft stems
- No flowering
- Tasty and dark green colour

Combining quality and quantity

Les't have a look how much protein and energy we can produce with each kind of forages

Grass	Average DM (ton/ha)	Edible fraction	Edible fraction of DM (ton/ha)	Un-edible fraction of DM (ton/ha)
Elephant	40	60%	24	16
VA06	48	60%	28.8	19.2
Guinea TD58	33	95%	31.5	1.5
Mulato 2	38	95%	36.1	1.9
Australian mix	42.5	95%	40.4	2.4

Edible fraction of DM (ton/ha) = DM yield (ton/ha) * Edible fraction (%)

Un-edible fraction of DM (ton/ha) = DM yield (ton/ha) - Edible fraction of DM (ton/ha)

Example: Compare Elephant grass with Guinea grass

1. How much can my cow eat of it:

		Edible fraction
Elephant grass	: 30% leaves + 70% stems	60 %
Guinea grass	: 85% leaves + 15% stems	95 %

→ *Cows like to eat Guinea more than Elephant grass*

Guinea grass

Elephant grass

2. Dry matter content:

Elephant grass : 16%
Guinea grass : 22%

→ *It means that 1 kg of fresh Elephant and Guinea grasses contain 0.16kg and 0.22 kg DM, respectively*

3. What is inside the dry matter? That is CP and Energy!

Elephant grass : CP = 7%; Energy = 7.4MJ
Guinea grass : CP = 12%, Energy = 8MJ

Calculation DM, CP, ME amount in 1 kg of Elephant grass and 1 kg Guinea grass

1 kg fresh Elephant grass

DM amount (kg) = 1 kg * 16% = 0.16 kg DM
CP amount (kg) = 0.16 kg DM * 7% = 0.0112 kg CP or 11.2 g CP
Energy amount (MJ) = 0.16 kg DM * 7.4 MJ = 1.184MJ

1 kg fresh Guinea grass

DM amount (kg) = 1 kg * 22% = 0.22 kg DM
CP amount (kg) = 0.22 kg DM * 12% = 0.0264 kg CP or 26.4 g CP
Energy amount (MJ) = 0.22 kg DM * 8 MJ = 1.76MJ

So, 1 kg of Guinea grass has 2.4 x as much protein and 1.5 x as much energy than Elephant grass.

Conclusion: *For the cow's point of view, Guinea grass is a much better grass than Elephant grass.*

4.3. Concentrates

Concentrates provide the additional Energy and Protein needed

Concentrates:

- High in Protein and Energy
- Low in fiber
- Rapid fermentation and fast digestion

The amount of concentrate needed should be calculated based

- Body weight
- The milk production
- CP and ME content in forages
- The forage and concentrate ratio (see part 2)

Concentrates should be provided in small volumes

- NEVER dilute in water
- NEVER cook before feeding
- NEVER give too much

Concentrate ingredients include:

Soya bean, bean, soya bean cake, oil cakes…

Grains

Rice, rice bran and wheat bran

Ground corn meal

Cassava meal

Chapter 1: The basis of ruminant nutrition, digestion and feeding

Concentrates can be grouped in:

Complete commercial concentrates (meal, pellets)

Condensed commercial concentrates

Complete homemade concentrates

Protein and Energy block

By products

Advantages and disadvantages of homemade and factory concentrate

	Home made	Factory products
Advantage	Cheaper	Nutrition balanced
	Uses locally available resources	Convenience
	Flexible formulation	Easy to store
Disadvantage	All materials have to be prepared	Higher price
	Need the formulation and labor cost	The quality in the labels sometime is not true

In many cases the best solution is to use condensed commercial concentrate and mix with available ingredients:

A good quality basis (Protein and Energy)

Flexibility for formula (depending on price and availability of ingredients)

Some homemade concentrate formulation and the nutritive values

Ingredients (%)	Formulation				
	F1	F2	F3	F4	F5
Rice bran or broken rice	20	20	22	20	20
Dried cassava root meal	16	16	10		
Corn grain ground	25	25	30	40	40
Fishmeal	2	2	1	1	1
Soya bean cake (CP=44%)	15.5		15	30	
Soya bean meal, roast	15				30
bone, sell meal	2	2	1	1	1
Salt white	1	1	0.5	0.5	0.5
DCP (Ca: 17% ; P: 21%)	1	1	3		
Peter Hand Premix				5	5
Condensed protein (CP> 40%)		30.5	15		
$NaHCO_3$	2.5	2.5	2.5	2.5	2.5
Total	***100***	***100***	***100***	***100***	***100***
Nutritive value					
CP (%)	19.9	18.1	19.0	20.8	19.8
ME (MJ)	12.8	12.2	12.2	12.2	12.3
NDF (%)	9	8.8	8.7	10.1	10.4
Ca (%)	1.25	1.27	1.12	1.36	1.23
P (%)	0.95	0.96	0.71	0.81	0.79

Note: 1 kg of this concentrate will produce 2 kg of milk (see page … in Chapter 2)

4.4. By-products

Advantages:

- By products are waste products from agricultural of industrial processes
- By-products can be used to partly replace forages or concentrate
- Using such by products is cheap and environmentally friendly
- Some by products have very high quality

Disadvantages

- Availability unstable
- Sometimes difficult to transport or store
- Some have low quality

4.5. Additives

MINERALS

Minerals are important for:

- Good body functions
- Growth (bones)
- Growth of fetus
- Milk production

The minerals needed in largest amounts (macro minerals) by the dairy cow include: calcium, phosphorus, magnesium, sodium, chlorine, sulfur, and potassium. Sodium and chlorine usually are provided in the form of salt.

Minerals required in small amounts (trace minerals) include iron, copper, manganese, zinc, iodine, cobalt, and selenium

A part of the minerals are provided in the forages, mainly Ca and K.

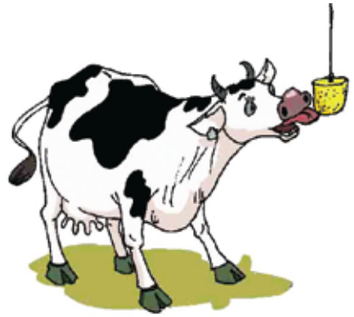
But more minerals (Ca, P, and others) need to be added to the diet by:

Add to the concentrate

Mineral block

Use a mineral block!

Cows know if they need more minerals! They will lick from the mineral block if they need more.



Minerals block should always be available, even if you use mineral powder as well

- A common sign of a lack of minerals is a cow that has difficulty to walk. Especially, when the high producing cows have these problems.
- Don't provide an access of Ca & P before calving
  This might be cause health problems after calving

UREA:

- Urea: Non –Protein Nitrogen
- Ruminants can use urea as nitrogen source.
- Bacteria in the rumen will transform urea into useful protein for the cow.
- However, too much urea can be poisonous

Utilization

- Use urea to supplement low protein diet
- Maximum supplementation amount should not exceed 90gr/cow/day.
- Spray or mix with forage or concentrate
- Urea should only be used **from day 0-200 days in milk**

- Gradually introduce to the cow over a period of 5 to 20 days for adaptation

Note

- Be careful to use urea. Ask technical advice before using urea
- Never use urea for calves (poisonous)
- Never dissolve urea with water for drinking
- Never use urea as sole feed

Chapter 2:

THE BASIC OF GOOD FEEDING MANAGEMENT

1. Introduction

Farmers raise dairy cows to produce milk and to make a profit.

Feeding is the biggest cost in milk production.

Improving feeding should focus on:

- Maximise the of potential milk production of cow
- Decrease the cost of production

TWO basic principles are:

1. THE MORE A COW CAN EAT, THE MORE MILK SHE CAN PRODUCE!

- Always try to increase the feed intake of your cows!

2. FORAGES ARE CHEAP, CONCENTRATES ARE EXPENSIVE!

- A dairy cow should eat as much good quality forages as possible:
- The more nutrition we can provide inside the forages, the less concentrate we need to add, the cheaper the diet!

Cheap!

Expensive!

Something to think about...

The cow is the one to produce the milk. So we should give the cow what she needs.

This sound obvious, however, in reality many farmers give the feed that is convenient for them, but is not what the cow really needs.

Cow like this grass!

Cow don't like this grass!

Some rules of the good feeding management

Rule 1: Water is always available

- Cows need a lot of water.
- It should be available at all time, clean, tasty and fresh

Rule 2: Feed forages *ad libitum*

- Forages should always be available in the feeding trough
- If there is no feed, dry matter intake is low and they produce less milk

Rule 3: Provide concentrate in small amounts

- Too much concentrate at one time is not healthy for a cow
- Concentrate should be provided at least 3 times per day
- It is best way to mix forages and concentrate

Rule 4: Always provide a mineral block

- Cows know when they need more minerals
- A mineral block guarantees that cows take up sufficient minerals

Rule 5: Increase forage intake as much as possible

- The more they eat, the more they produce
- Forage are cheap, concentrates expensive
- WHAT you give and HOW you give it will largely determine the feed intake!

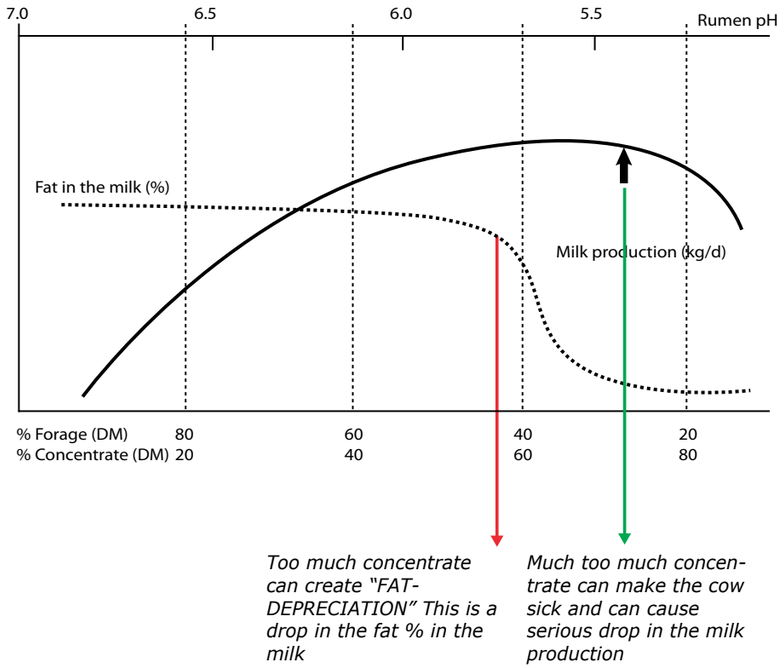
Rule 6: New feedstuff or ration should always be introduced gradually

- The rumen bacteria change according to the diet
- New feeds need to be introduced step by step, a little bit more every day for 7 to 10 days

2. The balance between forages and concentrate

The diet should always have a good forage/concentrate ratio

The figure below shows the effect of too much concentrate



3. The phases during a lactation cycle

A dairy cow produces milk for about 305 days, followed by a dry period of about 60days.

During such cycle of 365 days, several aspect of the cow depend largely on the stage of lactation:

The milk production:

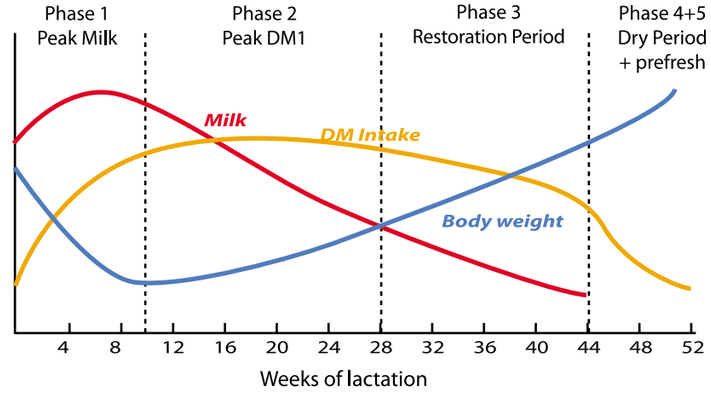
- Peaks 5-6 weeks into the lactation and gradually decreases until the end of the lactation.

The body weight:

- Is lowest 10 to 14 weeks into the lactation and increase gradually increases until next calving

The DM intake:

- Peaks 16 to 24 weeks into the lactation and decrease gradually until next calving



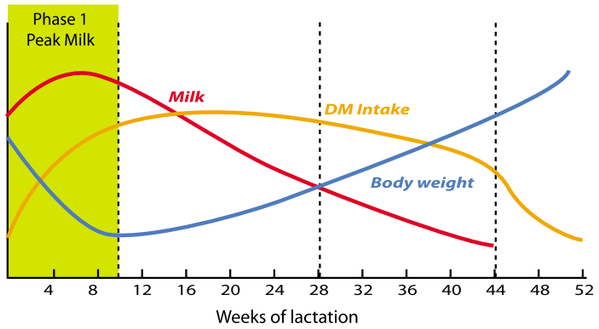
Nutritional requirements vary with the stage of lactation. For feeding practices, we define 5 distinct phases during this 365-day period

1- **Phase 1:** Early lactation: 0 to 70 DIM (Days In Milk) (peak milk production)
2- **Phase 2:** Mid lactation: 70 to 200 DIM (peak DM feed intake)
3- **Phase 3:** Late lactation: 200 to 305 DIM (restoration phase)
4- **Phase 4:** Dry period: 60 to 14 days before the next lactation
5- **Phase 5:** Transition or close-up period: 14 days before to calving

Phase	Milking			Dry	
	I	II	III	IV	V
	Early (0-70 DIM)	Mid (70-200 DIM)	Late (200-305DIM)	Dry (60 days before calving)	Prefresh (14 day before calving)
CP,% of DM	17.5-19.5	15-17	14-15	12	14.5-15
Ration forage min, %	40-45	45-50	50-55	60	55
ADF min, % of DM	17-21	19-22	21-25	30-35	25-29

Source NRC 1989

Phase 1. Early lactation (0 to 70 DIM)



Cow needs high quality forage

Excellent feeding regime during this period is very important to obtain maximum production!

Characteristics

- Milk production increases rapidly, peaking at 6 to 8 weeks after calving.
- Feed intake does not meet the energy requirements → cow uses reserves stored in its body → cow looses body weight.

Requirements:

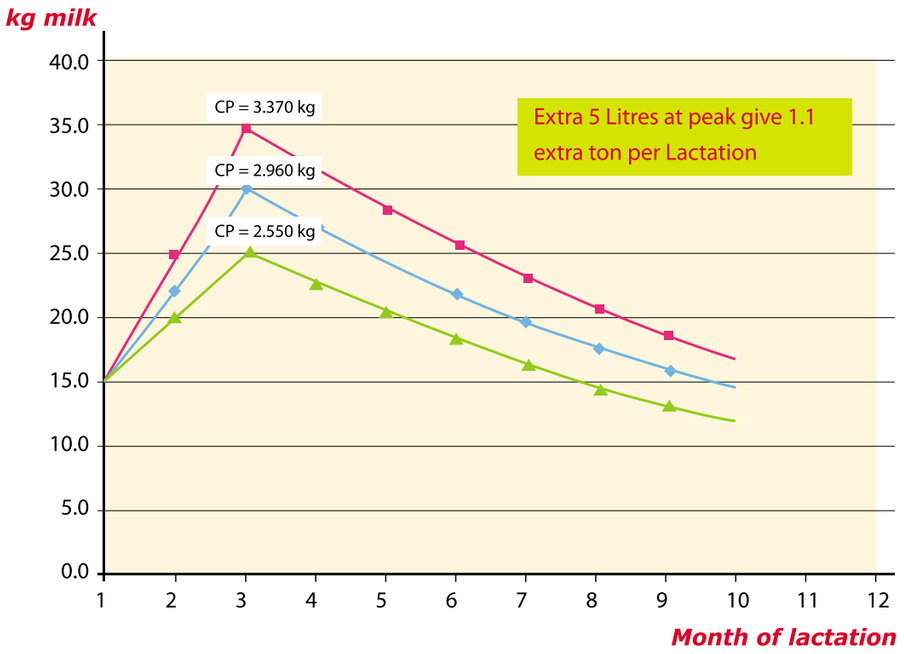
- CP: 17.5 -19.5% of DM
- Forage ration level in the total ration > 45%

Feeding: Aim at reaching the highest milk production peak possible!

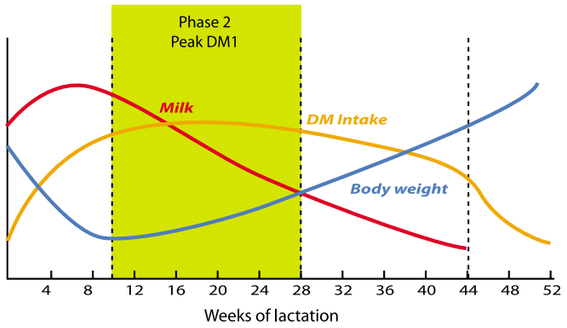
- Feed top quality forage such as Guinea grass, Australia mix, Mulato 2, Alfalfa hay. Allow constant access to feed!
- Increasing concentrate 0.5 kg per day from day 10 up to day 20. Do not give more than 60% of DM as concentrate because it will make the rumen too acid (= acidosis)
- Make sure the diet contains adequate amounts of CP (17.5 – 19.5%)
- Make sure the diet contains adequate % of forage: more than 45%
- Consider adding fat (Example: Megafat) from 0.1 to 0.3 kg/cow/day to diets.
- Minimize stress conditions.
- Provide a mineral block

REMEMBER THIS:

- A lower peak production translates into a lower total production during this lactation:
- A loss of 1 kg in peak milk production equates to a 220 kg loss for the lactation!



Phase 2. Mid lactation (70-200 DIM)



Cow being inseminated

If the cow is not inseminated yet, it should happen in the beginning of this period. Preferably before 85 DIM, but certainly before 140 DIM. Good feeding management in this period will results in successful inseminations prolonged high milk production and increasing body weight.

Characteristics

- Milk production has passed its peak and starts to decrease.
- Feed intake reaches its peak
- Body weight starts to increase again

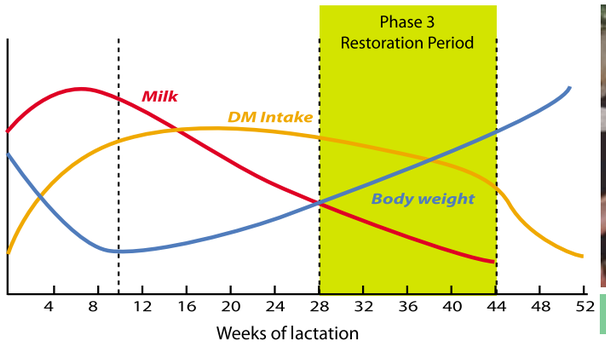
Requirements:

- CP: 15 - 17% of DM
- Forage ration level in the total ration > 50%

Feeding: **Aim at increasing feed intake!**

- Feed the highest quality feeds available (high quality forages).
- Feed forages and concentrate several times a day.
- Make sure the diet contains adequate CP% and forage %
- Supplement minerals and provide a mineral block.
- Continue to minimize stress conditions.

Phase 3. Late lactation (200 to 305 DIM)



The body weight increases

This phase will be the easiest to manage. It is important to make sure the cows are in good condition to be dried off.

Characteristics

- Milk production is declining (8-10% drop per month)
- The cow is pregnant, and nutrient intake will easily meet or exceed requirements.
- The body weight increases. Avoid making the cows to fat.

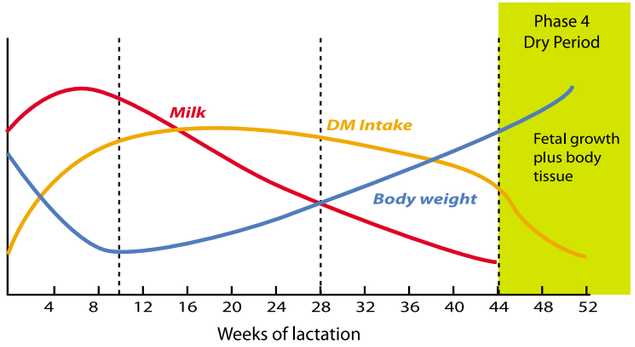
Requirements:

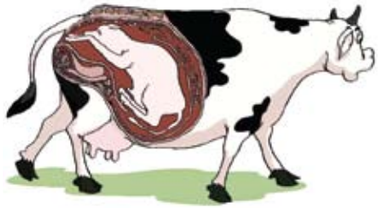
- CP: 14 - 15% of DM
- Forage ration level in the total ration > 55%

Feeding: Aim at having the cows in good condition for the dry period!

- Feed a mixture of forages and make sure the cow eats at least 55% of DM as forage.
- Higher concentrate amounts will not result in higher milk output but will increase the cost and make your cows too fat!
- Feed an adequate amount of concentrate in several times a day.
- Make sure the diet contains adequate CP%
- Provide a mineral block.
- Continue to minimize stress conditions.

Phase 4. Dry period—60 to 14 days before parturition.





Late pregnant period

The dry period is a critical phase of the lactation cycle. A good dry cow program can increase milk yield during the following lactation and minimize metabolic problems.

Characteristics

- No milk production
- Body weight increasing
- Feed intake decreasing

Requirements:

- CP: 12% of DM
- Forage ration level in the total ration > 60%
- Ca: 60-80gr/day
- P: 30-40gr/day

Feeding: Aim at adjusting feeding to have a correct body score for calving

- Separate from lactating cows
- Observe body condition of dry cows and adjust energy feeding as necessary
- Make sure the cows don't become too fat: this will increase the change for problems after calving
- Increase forage to restore rumen. Forage level in the ration at least 60%
- Forage can include some lower quality forages such as corn stover, Elephant grass or rice straw…
- Provide correct amounts of Ca and P. Avoid excess calcium and phosphorus intakes. This will increase problems of milk fever.
- Provide adequate amounts of vitamin A, D, and E in rations to improve calf survival and lower retained placenta and milk fever problems.
- Limit salt to 28gr and limit other sodium-based minerals in the dry cow ration to reduce udder edema problems.
- Change to a transition ration starting 2 weeks before calving.

This cow is too fat because of overfeeding

Never supplement Mineral Lick Block in this period!

Phase 5. Transition period—14 days before calving.

The transition or close-up dry cow feeding program is critical to adjusting dry cows and springing heifers to the lactation ration and preventing metabolic problems.

Characteristics

- No milk production
- Body weight increasing
- Feed intake decreasing

Requirements:

- CP: 14.5 to 15% of DM
- Forage ration level in the total ration > 55%
- Ca: 60-80gr/day
- P: 30-40gr/day

This cow has a good body condition at calving

Feeding: Aim at preparing the rumen for the lactating period

Continue with same forages as in previous stage (dry cow)

- Increase concentrate gradually to 2.5 to 3 kg to adapt rumen bacteria
- Remove salt from the ration if edema is a problem.
- If niacin (to control ketosis) and/or anionic salts (to help prevent milk fever) are going to be used, they should be included in the ration during this period.

4. Ration formulation for lactating cows

4.1 Objective of ration formulation

- Provide a balanced nutrition (forage/concentrate ratio)
- Provide a diet that meet the requirement at the different period of the lactation
- Provide a diet that allows the cows to reach high peak production and maintain a high production for a long period
- Provide the nutrients in the cheapest way possible
- Provide a diet that will result in a high feed intake

4.2 Dry Matter intake

High DM feed intake

Low DM feed intake

Ratio calculation uses DMI.

Remember that DMI of forage depends on a number of factors:

Ration moisture:

- DM of the ration increase → DMI increase
- Optimum DM of the ration: 45-55%

Ration palatability

- High palatable → DMI increase
- High in fiber (NDF>25%) → DMI decrease
- Increase concentrate in the diet up to 60% of DM increased DMI.

Weather

- Hot climate (high temperature and humidity) → decrease DMI

Feeding methods

- Feeding frequency → increase DMI
- Chopping → increase DMI
- Sundry fresh forages → increase DMI
- Mix forages and concentrate → optimum DMI

4.3. Feed intake ≠ feed offer!

Feed offered

Feed refusal

All the ration calculation gives you feed intake data.

- For concentrates, feed offer and feed intake is the same because cows eats 100% of was is provided.
- For forages, there is a considerable difference between feed offer and feed intake depending on the quality of the forage.

4.4. Important rules of thumb for ratio calculation for lactating Cows

1. Dry Matter Intake (DMI) should be known.
2. Forage DMI should always be minimum 1.5% of body weight or 40% of total DMI
3. Concentrate DMI should never be more than 2 % of body weight.or 60% of total DMI
4. Minimum ADF is 18% of DM.
5. Limit urea to 90 gr/cow/day in the period of 0-200 DIM.
6. Salt should be 1% of the concentrate DM
7. Calcium/Phosphorus balance should be 2/1. Together it should be 1-2% in concentrate DM

4.5. Ratio calculation

Overview of different steps:

1. Estimate Total DMI
2. Check % forage DMI
3. Check the CP% of total diet
4. Check total energy in the diet
5. Adjust if needed and repeat step 3&4
6. Convert DM

STEP 1: Estimate total DMI

Based on the body weight and milk production, use table 1 to estimate Total DMI.

Table 1: Total Dry Matter Intake (as % of body weight)

Milk (kg/day)	% of body weight					
	350 kg	400 kg	450kg	500 kg	550 kg	600 kg
10	2.6	2.4	2.3	2.2	2.1	2.0
12.5	2.8	2.65	**2.5**	2.4	2.35	2.15
15	3.0	2.9	**2.7**	2.6	2.5	2.3
17.5	3.2	3.1	2.9	2.75	2.65	**2.4**
20	3.4	3.3	3.1	2.9	2.8	2.5
22.5	3.6	3.45	3.25	3.05	2.95	2.6
25	3.8	3.6	3.4	3.2	3.1	2.8
27.5	3.95	3.7	3.55	3.35	3.25	2.95
30	4.1	3.8	3.7	3.5	3.4	3.1
32.5	4.3	4.0	3.85	3.65	3.5	3.25
35	4.6	4.2	4.0	3.8	**3.6**	3.3
37.5	4.85	4.4	4.15	3.95	3.75	3.4
40	5.1	4.6	4.3	4.1	3.8	3.5
45			4.7	4.4	4.1	3.7
50			5.0	4.7	4.4	3.9

*Total DMI = body weight * %body weight (from Table 1) /100*

STEP 2: Check the minimum % forage

Check the minimum % of forage needed in the diet based on milk production and phase of the lactation in Table 2.

Table 2: % forage in DMI

Milk prod	0-70 DIM	71-200 DIM	200-305 DIM
Below 20kg	55%	60%	70%
20-25kg	52%	57%	65%
25-30kg	48%	53%	60%
above 30kg	45%	50%	55%

Calculate % forage DM and concentrate DM

Forage DM = DMI (see step 1) % Forage (from Table 2)*

Concentrate DM = DMI (see step 1) (100- %forage)*

STEP 3 Check CP of total diet

Check if the CP% of the total diet is in line with the needs according the phase of the lactation in Table 3.

Table 3: CP% according to phase in lactation

Phase	Days in Milk (DIM)	CP% needed
Early	0-70	17.5 – 19.5%
Mid	71-200	15 -17%
Late	200- end of lactation	14 -15%

*CP% diet = ((DM forage * CP forage) + (DM conc * CP conc))/ Total DMI*

Compare the result with data in Table 3.

STEP 4: Check the Energy content of the diet

Calculate the total energy needed for maintenance according to the body weight (Table 4)

Table 4: Energy for maintenance according to body weight

Body weight (kg)	ME (MJ/day)
350	39
400	43
450	47
500	51
550	55
600	58

Calculate the energy needed for the milk production: kg Milk/day * 5MJ

Note: This is based on milk with 3.5 -3.7 % fat. If the milk has high fat% the energy per kg milk is higher: 4.0 % fat: 5.3 MJ/kg; 4,5% fat 5.5 MJ/kg

Calculate the total energy needed by adding energy for maintenance and milk production

Energy needed (MJ) = Maintenance (Table 4) + kg milk * 5MJ

Calculate the total energy in the diet:

MJ in diet= (DM forage * MJ forage) + (DM conc * MJ conc)

STEP 5: Adjust and recalculate if needed

If CP or energy in the diet is too low:

- Increase forage feed intake
- Use forage with higher CP % and/or energy
- Use concentrate with higher CP% and/or energy
- Use urea up to 90gr/cow/day to correct a too low CP

If CP is too high

- Reduce amount of concentrate
- Reduce CP% and/or energy content in the concentrate

Calculation feeding ratio's is an important aspect of dairy farming

For small difference, increase or decrease the amount of concentrate.

Repeat step 3 & 4 after you made the adjustments.

STEP 6: Convert DM

Divide the calculated kg DM forage and concentrate by the known DM%.

Forage: kg DM forage/%DM of forage = fresh kg forage

Concentrate kg DM concentrate/%DM conc = kg concentrate

SUMMARY

Step 1: Total DMI = body weight * %body weight (from Table 1) /100

Step 2: Forage DM = Total DMI * % Forage (from Table 2)

Concentrate DM = Total DMI * (100- %forage)

Step 3: CP% diet = ((DM forage*CP forage)+(DM conc * CP conc))/ Total DMI

Compare with Table 3

Step 4: MJ in diet= (DM forage* MJ forage) + (DM conc * MJ conc)

Compare with: Maintenance (Table 4) + kg milk * 5MJ

Step 5: Adjust if necessary

Step 6: Forage: kg DM forage/%DM forage = fresh kg forage

Concentrate: kg DM conc/%DM conc = kg conc

Example 1: Cow 600 Kg, 18 Kg milk/day, 180 days in milk, AM (DM: 15%, CP: 14%, ME: 8.5MJ) , concentrate (DM: 87%, CP: 18%, ME: 12.5MJ)

Step 1: Total DMI
600kg cow with 18L milk = **2.4%**
600* 0.024 = 14.4 kg

Step 2: % forage
180 DIM with 18kg = 60% forage
Forage: 14.4 * 0.6= 8.6 kg DM forage
Concentrate: 14.4 * 0.4 = 5.8 kg DM concentrate

Step 3: Check %CP
CP needed: 180DIM = 15 -17% CP
CP% = ((8.6*14)+(5.8*18))/14.4= 15.6% **OK**

Step 4: Check Energy
Energy needed = 58 + (18*5) =148 MJ
Energy available = (8.6*8.5)+(5.8*12.5)= 145.5 MJ **OK**

Step 5: Adjust
Not needed.

Step 6: Convert DM into fresh
Forage: 8.6 kg DM / 0.15 DM/kg AM = 57 kg fresh
Concentrate: 5.8 kg DM/0.87= 6.7 kg concentrate

Example 2: Cow 450 Kg, 14 Kg milk/day, 210 DIM, Forage mix of guinea and para grass (DM: 20%, CP: 13%, ME: 8.0 MJ), concentrate (DM: 87%, CP: 17%, ME: 12,5 MJ)

Step 1: Total DMI
450kg cow with 14L milk = **2.6%**
450* 0.026 = 11.7 kg

Step 2: % forage
210 DIM with 14kg = 70% forage
Forage: 11.7 * 0.7= 8.2 kg DM forage
Concentrate: 11.7 * 0.3 = 3.5 kg DM concentrate

Step 3: Check %CP
CP needed: 210DIM = 14 -15% CP
CP% = ((8.2*13)+(3.5*17))/11.7= 14.2% **OK**

Step 4: Check Energy
Energy needed = 47 + (14*5) =117 MJ
Energy available = (8.2*8.0)+(3,5*12.5)= 109.3 MJ (shortage of 7.7 MJ)

Step 5: Adjust
Add 0.5 kg DM concentrate
Repeat step 3: CP% = ((8.2*13)+(4*17))/12.2= 14.3% **OK**
Repeat step 4: Energy = (8.2*8.0)+(4*12.5)= 115.6 MJ **OK**

Step 6: Convert DM into fresh
Forage: 8.2 kg DM / 0.2 DM/kg AM = 41 kg fresh
Concentrate: 4 kg DM/0.87= 4.6 kg concentrate

Example 3: 550kg cow, 35kg milk, 60 DIM , forages: 50/50 mix of guinea and AM (DM guinea: 22%, DM of AM: 15%, CP mix: 14%), Conc (DM: 87%, CP: 23%, ME: 12.5MJ)

Step 1: Total DMI
550kg cow with 35L milk = **3.6%**
550* 0.036 = 19.8 kg

Step 2: % forage
60 DIM with 35kg = 45% forage
Forage: 19.8 * 0.45= 8.9 kg DM forage
Concentrate: 19.8 * 0.55 = 10.89 kg DM concentrate

Step 3: Check %CP
CP needed: 60DIM = 17.5- 19.5% CP
CP% = ((8.9*14)+(10.89*23))/19.8= **18.9%** **OK**

Step 4: Check Energy
Energy needed = 55 + (35*5) = 230 MJ
Energy available = (8.9*8.5)+(10.89*12.5)= **211.8 MJ** **(-18.2MJ)**

Step 5: Adjust
Add 2.5 kg molasses (DM: 63%, CP: 2.5%, ME: 13MJ)
Repeat step 3: CP (%) = ((1.6 * 2.5) + (8.9 * 14) + (10.89 * 23))/21.4 = **17.7%** **OK**
Repeat step 4: Energy = (1.6 * 8.3) + (8.9 * 8.5) + (10.89 * 13) = **230,5 MJ** **OK**

Step 6: Convert DM into fresh
Forage: Guinea (8.9 kg DM /2)/ 0.22 = 20.3 kg Guinea
AM (8.9kg DM /2)/ 0.15 = 29.7 kg AM
Concentrate: 10.89kg DM/0.87 = 12.5 kg concentrate
Molasses: 2.5 kg

Example 4: Cow 500 kg, 30 kg milk/day, 50 DIM, Guinea grass (DM: 22%, CP: 11%, ME: 7.5 MJ), Concentrate (DM: 87%, CP: 21%, ME: 12.5 MJ)

Step 1: Total DMI
500kg cow with 30L milk = **3.5%**
500* 0.035 = 17.5kg DM

Step 2: % forage
50 DIM with 30kg = 45% forage
Forage: 17.5 * 0.45 = 7.9 kg DM forage
Concentrate: 17.5* 0.55 = 9.6 kg DM concentrate

Step 3: Check %CP
CP needed: 50DIM = 17.5- 19.5% CP
CP% = ((7.9*11)+(9.6*21))/17.5= **16.5%** **TOO LOW**

Step 4: Check Energy
Energy needed = 51 + (30*5) = 201 MJ
Energy available = (7.9*7.5)+(9.6*12.5)= **179 MJ** **TOO LOW**

Step 5: Adjust
It is impossible to formulate a suitable diet with the available concentrate and forage. Increase CP and energy content of concentrate and/or provide forage with higher protein and energy content.
For example: Replace 3 kg DM of forages with 3 kg DM alfalfa hay in the diet (CP 21%, ME 10 MJ) and use concentrate with CP 23% and 14 MJ.
Repeat step 3: CP% = ((4.9*11)+(3*21)+(9.6*23))/17.5= 19.3% **OK**
Repeat step 4: Energy = (4.9*7.5)+(3*10)+(9.6*14)=201 MJ **OK**

Step 6: Convert DM into fresh
Forage: Guinea 4.9 kg DM/ 0.22 = 22 kg Guinea
Alfalfa hay 3 kg DM/0.9 = 3.3 kg Alfalfa
Concentrate: 9.6 kg DM/0.87= 11 kg concentrate

The most important pieces of advice!

Adapt your feeding to what your cows tells you:

Measure and interpret her total DMI and forage DMI

- Make sure your cow eat sufficient forage
- If she doesn't, change the way you feed her (feed content and feeding method)

Determine her body score and react on it

- If according to Body Scoring (see chapter 5):
- Cow is too fat: give less concentrate
- Cow is too skinny: give more concentrate

Cow BSC1: To thin

Cow BSC5: To fat

Nutritive value of selected forages

The nutritive value of 50 kg grasses are calculated in the table below:

Grass	Forage intake (kg/ day)	DM content (%)	CP content (%of DM)	ME Content (MJ/ kgDM)	DM intake (kg/ day)	CP intake (kg/ day)	ME intake (MJ/ day)
Elephant	50	16%	7%	7.0	8.0	0.56	56
VA06	50	16%	7.50%	7.0	8.0	0.60	56
Guinea TD58	50	22%	12%	7.4	11.0	1.32	81.4
Mulato 2	50	19%	13%	7.2	9.5	1.24	68.4
Australian mix	50	17%	13.50%	7.2	8.5	1.15	61.2
Para grass	50	19%	13%	7.2	9.5	1.24	68.4
…							

To help you further understand the differences between these forage, we calculate how much milk can be produced out of 50 kg fresh grass intake by a 500 kg cow.

Grass	ME Intake (MJ/ day)	CP intake (kg/ day)	Used for Maintenance		Left for milk production		Milk produced out of forage (kg/day)	
			ME (MJ)	CP (kg/d)	ME (MJ)	CP (kg/d)	ME	CP
Elephant	56	0.56	50.8	0.423	5.2	0.14	1.04	1.71
VA06	56	0.60	50.8	0.423	5.2	0.18	1.04	2.20
Guinea TD58	81.4	1.32	50.8	0.423	30.6	0.90	6.12	10.98
Mulato 2	68.4	1.24	50.8	0.423	17.6	0.81	3.52	9.88
Australian mix	61.2	1.15	50.8	0.423	10.4	0.72	2.08	8.78
Para grass	68.2	1.24	50.8	0.423	...	...	...	...

Compare Elephant grass with Guinea:

50kg Elephant grass is sufficient for maintename + 1 kg Milk

50kg Guinea is sufficient for maintename + 6 kg milk

Chapter 3:

FORAGE PRODUCTION AND STORAGE

1. Cultivating forages

- Selection of suitable area

- Forages are like vegetables. They grow faster if the soil is better

How to increase forage production in terms of quantity and quality?

Improve soil conditions:

Many soils are poor in organic matter

Use organic fertilizer

Apply fertilizer (organic and chemical NPK -urea)

Appropriate harvesting time

Apply irrigation (Manual or sprinklers)

Select better forage species

Selection of forages

When you choice the kind of forage, you should think about the following aspects:

- The cow's needs
- Climate conditions
- Land characteristics
- Investment
- Purpose/used
- Experience

1.1. Cow's needs!

Cow's needs!

High quality forages (High Protein, Energy contents)

Palatability (more leaves and young stage)

1.2. Climate conditions: depending on your farm's location

Temperate forages: They can not withstand hot weather

Avena sativa

Avex

Tropical forages: Low production in cold weather

Guinea TD58

Long Para

Mulato 2

Australian mix

Elephant grass

1.3. Land characteristics

- Upland: Guinea, Ruri… (tolerant with drought)
- Delta land (Alluvial, ….): All kind of grass…
- Lowland (Wetland: rice field land, waterlogged field…): Para grass,

Guinea grass

Para grass

1.4. Potential investment

Do you want to invest in automatic irrigation (sprinkler system)?

Setting up an irrigation systems

- Allows you get high production of high quality forages such as Australian mix, Mulato, …
- Gives you an opportunity to use effluent efficiently (fertigation= irrigation + fertilisation)

Automatic irrigation system high quality forages

1.5. Purpose:

All year round production

- For hay production: Ruzi grass, AM, Mulato…
- For silage production: Possible with almost all forages, but especially whole corn is recommended for silage production.
- For dual-purpose: As living fence such as leuceana

For hay

Making silage

For dual-purpose

1.6. Experience

- Your own experience
- Experience of neighbors or advisors

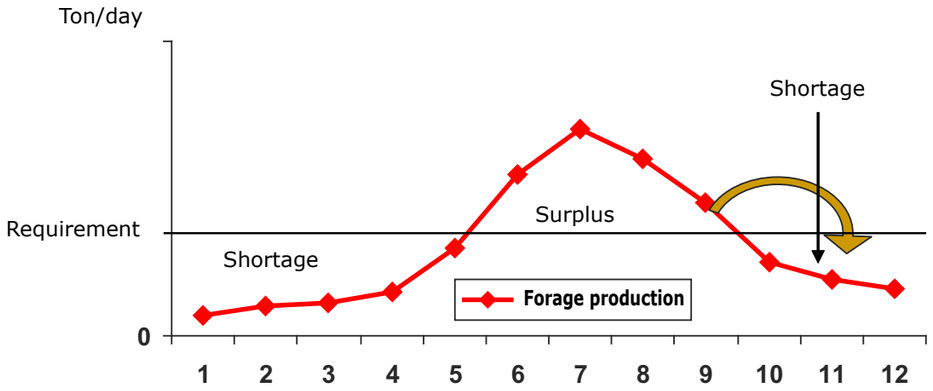
Growing forages is not difficult, but advise from someone with experience is helpful when you try out new kinds

2. Storage

Forage production in a year

Tropical forages (Elephant grass, Guinea, Ruzi…) grow mainly in rainy season.

- Rainy season production (May-October): 70%-80% of total biomass
- Dry season production (November-April): only 20%-30% of the total.



Forages are mostly used fresh. However in some cases it is interesting to store them for a period of time.

Some over-production in the summer to be used in the winter

2.1. Making silage

- Storage and processing green forages
- Reduce or eliminate toxin .
- Improving the diet's palatability and daily feed intake

Cultivating forages

Materials

- Green forages
- Corn stover and agro by-products

Corn stover

Note: The quality of silage depends raw materials.

Facilities

- Concrete tank
- Barrel
- Plastic bag...

Plastic bags are the most efficient for small dairy farmers and versatile because in addition to its low cost, it can be placed anywhere and it is easy to check the quality of silage...

Plastic bags

Note: Keep and place plastic bag under the shade to avoid sunlight's effect on the quality of silage and plastic bags.

Preparation before making silage

Materials

- Quantify the materials for ensilage
- Material status:
  - If the materials have a low dry matter content → sundry
  - If the materials are too old and high dry matter → mix them with young and juicy ones
- Chop into small pieces (1-3 cm)

Chopping materials

Additives:

- Bran (corn bran, rice bran, cassava root meal): 2-3% to stimulate fermentation
- Molasses: 2-3% to stimulate fermentation and increase the scent
- Salt: 0,5% to create buffer solution

Note:

- Never make silage when it rains
- Whole corn stover → do not need to add bran and molasses
- Ideally, DM of the raw materials for silage are 30-35%

Ensilage protocol

- Step 1: Close the bag by typing the top with rubber string. Put the chopped forage into a plastic bag in layers of 20 cm
- Step 2: Sprinkle the molasses and spread other additives on each layer
- Step 3: Press by standing inside the plastic the bag and walk around, and add chopped forage repeatedly to ensure an evently spread until the bag is full
- Step 4: Press out the air inside the plastic bag, tie the top of the plastic tightly with rubber string
- Step 5: Store under the shade, avoid the sun-light or rain. After one month, it can be used as feed for the cow.

Note: The life time of the ensilage depends on quality of raw materials (the higher quality, the shorter the life time). The best life time is within the second to the third month.

Quality of silage

Good quality: Light-acidity smell, light-yellow

Bad quality: Black, bad smell or moldy

How to feed

- Introduce silage to the cow gradually
- As the pH of the silage is low (4.2-4.5), do not feed the cows as a sole feed, especially when they are hungry. Mix silage with other forages to feed the cows.
- Amount: 5 kg of silage/100 kg of bodyweight

2.2. Urea treated rice straw (UTRS)

- To improve the nutritive value of rice straw (increasing digestibility)
- To improve voluntary DM intake
- To provide more inorganic protein
- For fresh rice straw:
  - Reduce labour cost for drying and no risk of the weather conditions
  - Avoid nutrients loss during drying

Material

Dry or fresh rice straw, urea, lime stone (if any)

Facilities

Similar to making silage

Protocol

- For dry rice straw: 100 kg of dry rice straw + 4 kg urea + 80-100 liters of water
- For fresh straw: 100 kg of fresh rice straw + 1.5 kg urea + 1 kg lime-stone

Rice straw treatment

Step 1:

- Weigh the rice straw
- Calculate the amount of urea, lime-stone (for fresh rice straw) and water needed

Step 2:

- For dry rice straw: Dissolve the urea in the water and spray → it thoroughly on the straw
- For fresh straw: Sprinkle urea directly on the straw

Step 3:

- Put the spraying rice straw into the bag until it is full
- Press out the air inside the plastic bag, tie the top of the plastic tightly with rubber string

Note: Another possibility is to sprinkle urea disolved or add urea directly on each of the layer (20 cm thick) of rice straw

Quality and Utilization

- UTRS can be used 2 weeks (in the summer) or 3 weeks (in the winter) after treatment
- Good treatment: Swelling, brown- yellow, strong smell
- UTRS should be used up within 3 months after being treated

Note: Take UTRS as fast as possible and tie up the bag immediately to avoid ammoniac loss.

How to feed

- Introduce UTRS gradually to the cow
- Don't feed grass to the cows in the morning
- Reduce the smell before feeding by scattering the straw
- Added molasses with UTRS to improve palatability
- When the cows are used to UTRS, it's not necessary to scatter the straw before feeding. Feed ad libitum

3. Hay

Some forages can be stored as hay

Cultivatied forages

Store in dry place

Rice straw

Dry in the sun

Storage

Chapter 4:

OVERVIEW OF FORAGES AND BY-FRODUCTS

Overview of commonly used forages in Vietnam

The forages are presented in 4 groups

1. Cultivated forages

2. Natural grasses

3. Imported forages

4. By - products

1. Cultivated forages

1.1. Guinea TD 58

Ecology

- Perennial, grows in densely tufted and fasciculated roots
- Grows on a wide range of soil types, grows fast in moiture soil, can tolerate in drought and shadows, and intolerate in prolonged flooding or waterlogging
- Produces best growth between 25-32°C, little growth below 15°C
- Production potential: 120-150 tons/ha/year. **Edible fraction >90%**
- Nutritive value: DM: 22%-28%, **CP: 10-13%** (higher quality and digestibility than Elephant grass)

Fertilizer

- Organic manure: 20-30 tons/ha
- Phosphorus sulfate: 350-400 kg/ha
- Potassium sulfate: 250-300 kg/ha
- Urea: 450-500 kg/ha

Basal fertilizing: Organic manure, Phosphorus sulfate, Potassium sulfate

Additional fertilizing: urea after harvesting

Planting

- Plant by seeds: 6-8 kg/ha
- By plants or branches: 4-5 branches per clump, removed 1/3 top of the leaves before planting. Planting materials: 4-6 tons/ha

Planting season: in rainy season. Ideally, from April to June

Planting techniques

By seed: well land preparation

- Distance between rows: 35-40 cm, row depth: 7-10 cm
- Well seeding and covered by soil of 1 cm

By plants (clump):

- Distance between rows: 35-40 cm, between clump: 20-25 cm, row depth: 15-20 cm,
- Placed and pressed into the row

Management

- Watering after planting if the soil is dry
- Weeding, check the suvival and re-plant
- Urea application after harvesting
- Re-planted after 4-5 years

Harvest

- First harvest: after 50-60 days and continuously after 35-40 days
- High cutting: 6-8cm above soil level. 6 to 8 cuttings/year

Utilization: Fresh or ensilaged

1.2. Mulato spp.

{Cv. Mulato 1 (B. brizantha x B. ruziziensis) and Cv. Mulato 2 (B. ruziziensis x B. decumbens x B. brizantha)}

Biological characteristics

- Perennial, polyrhizea, bushy.
- It can grow on well-drained soils of all soil with pH 4.5–8.0. Response strongly to added N on deficient soils, it likes humid environments, it is heat resistant, it's not able to stand in a flooded area for a long period of time.
- Temperature: tropical and warm subtropical, it grows bad if the temperature is below 150C (winter in Vietnam)
- Spreads rapidly by rooting from lower culm nodes
- Productivity: 150-250 tons/ha/year. Edible fraction >90%
- Quality: DM: 17-21%, CP: 11-15%

Fertilization

- Manure: 20-30 tons/ha
- Super phosphate: 350-400 kg/ha
- Sulfate Kali: 250-300 kg/ha
- Urea: 450-500 kg/ha
- Basic fertilizing: manure, phosphate and kali
- Additional fertilizing: urea after harvesting

Planting: In the rainy season. Ideally, from April to June

- By seeds: 4-6 kg/ha
  - Seeding in row in fine soil
  - Distance between rows: 30-35 cm, between seed 20-22 cm, row depth: 7-10 cm
  - Even distribution of seeds and cover up with soil: 1 cm

- By cutting:
  - 4-5 limbs should be planted at the same spot, leaves should be trimmed off before planting
  - Cutting material quantity: 4-5 tons/ha
  - Planting: the distance same as planting by seed. But, roots should be pressed into the soil.

Management

- If THE SOIL IS DRY, the soil needs to be irrigated from 7-10 days (one time/day).
- Weeding, check the germination and replant if necessary.
- ADDITIONAL FERTILIZATION of 60-70 kg NPK and 60 kg of urea/ha after harvesting.
- Replant after 4 to 5 years

Harvesting

- First harvest: 40-60 days after seeding, next harvest: after 20-30 days (in the rainy season), after 40-50 days (in the dry season)
- High cutting: 8-10 cm above land level. 9 to 10 harvests/year

Utilization:

Fresh, dried or ensilaged

1.3. Australian Mix

Biological characteristics

- AM is a mix of 5 tropical grasses: *Brachiaria decumbent (signal grass), Brachiaria brizantha, Digitaria milanjiana, Setaria sphacelate and Chloris gayana)* and 4 tropical legumes: *Clitoria ternatea, Macroptilium atropurpureum, Stylosanthes guianensis and Stylosanthes seabranna.*

- AM is Tropical forages, its growth start at temperatures > 15°C
- Spreads rapidly by rooting from lower culm nodes
- Productivity: 150-250 tons/ha/year. **Edible fraction >90%**
- Quality: DM: 15-21%, **CP: 12-15%**

Fertilization

- Organic manure: 20-40 tons/ha
- Super phosphate: 350-400 kg/ha
- Sulfate Kali: 250-300 kg/ha
- Urea: 500-600 kg/ha
- Basic fertilizing: Organic manure, phosphate and kali
- Additional fertilizing: urea after harvesting

Seed

Mix seed with sand and NPK

Planting:

- Soil: Well preparation
- By seeds: 10-12kg/ha
- Planting season: In the rainy season, ideally from April to June
- Planting techniques: Mix seed with sand, NPK and seeding by hand
- Cover the seeds by "sweeping" the surface with a branch

Seeding by hand

Management

- Irrigate immediately after seeding and for 7- 10 days
- Check the germination, but never weeding
- ADDITIONAL FERTILIZATION of 60-70 kg NPK and 60 kg of urea per ha after harvesting.
- Replanting after 5-6 years

After 60 days (1st harvest)

Harvesting

- First harvest: after 60-70 days, next harvest: after 20-30 days (in the rainy season), after 50-60 days (in the dry season)
- Grass is cut at 20 cm above soil level.
- 9 to 10 cuttings/year

Cut 20 cm above soil level

Utilization:

Fresh, dried or make silage

For more detail about the AM and Irrigation; See manual Implementation Irrigation For High Quality Grasses

1.4. Para grass

Ecology

- A Creeping perennial grass, very hairy
- Growth fast in low land, wet, swampy and flooded areas, intolerant drought
- It grows the whole year and the production potential in the dry season is about 50% of the total biomass
- Production potential: 50-80 tons/ha/year
- Nutritive value: DM: 19 - 21%; **CP: 12 - 16%, Edible fraction > 90%**

Fertilizer

- Organic manure: 10-15 tons/ha
- Phosphorus sulfate: 200-250 kg/ha
- Potassium sulfate: 150-200 kg/ha
- Urea: 200-250 kg/ha
- Lime stone: 500 kg/ha (for acidity soil)

Basal fertilizing:

Organic manure, Phosphorus sulfate, Potassium sulfate and lime stone

Additional fertilizing:

Urea after harvesting

Planting

- Plant by stem cutting, length of stem: 20-25cm
- Stem cutting materials: 2-3 tons/ha

Planting season:

Plant in the rainy season. Ideally, from April to June

Planting techniques

Moiture land

- Distance between rows: 40-50 cm
- Distance between clump: 20-25 cm
- Row depth: 15-20 cm
- Plant 3-4 cuttings per clump, at least 2 nodes should be buried into moist soil

For wet land: harrowe as rice field and hand-planted

Management

- Check the suvival and re-plant
- Weeding
- Urea application after harvesting
- Re-planted after 3-4 years

Harvest

- First harvest: after 50-60 days of planting, next harvest: high reaches of 40-60 cm
- High cutting: 10-15 cm above ground level
- 6 to 8 cuttings/year

Utilization: Use in fresh or make silage

1.5. Corn

Ecology

- A erect, fast growing and short-lived annual growing, the leaf is large, sharp, and fasciculated roots
- Has a high nutrient demand, adapted to well drained soil, intolerate in prolonged flooding or waterlogging and drought.
- Produces best growth between 18-33^{o}C, can growth when temperature >9^{o}C
- Production potential: depends on the purposes of use

Fertilizer

- Organic manure: 5-10 tons/ha
- NPK: 700-750 kg/ha
- Urea: 80-120 kg/ha
- Basic fertilizing: Organic manure, NPK
- Additional fertilizing: urea after 30 days and 50 days of planting

Sowing

- Plant by seeds
- Amount of seed:
  - For seed harvest: 25-35 kg/ha
  - For baby corn or forage: 70-80 kg/ha

Planting season: From March to November (should not sow if the temperature is below 15^{o}C)

Planting techniques

- Distance between rows: 40-50 cm
- Distance between seeds: 20-25 cm (for seed harvest), 5-10 cm (for baby corn and forage), with 2-3 seeds/hole

Management

- The check germination and replant
- Weeding
- Urea appplication (40 kg/ha) after 30 days and 50 days of planting

Harvest

- Seed harvest: When the corn stover change colour to yellow, the stover can be used as roughage (very low quality)
- Corn cob and baby corn harvest: the stover can be used as roughage
- Corn for forage: Harvest after 40 days to 60 days of planting

Utilization:

Fresh (chopped into small piece) or ensilaged

1.6. Avena and Avex

- A temperate mixed grasses with 2 non-leguminous and 3 leguminous varieties
- Grows well in **winter** season
- Production potential: 40-50 tons/ha in fresh
- Nutritive value: DM: 17 - 20%, **CP: 18 - 22%, Edible fraction > 90%**
- Plant in winter season (6 months)

Fertilizer

- Organic manure: 600kg/sao
- Phosphorus sulfate: 14 kg/ sao
- Potassium sulfate: 4 kg/sao
- Urea: 9-12 kg/sao

Basal fertilizing:

Organic manure, Phosphorus sulfate, Potassium sulfate:

Additional fertilizing:

Urea application (3kg/sao) after 10-15 days of planting and after harvesting

Planting: by seeds, seed amount: 1.8-2.0kg/sao

Planting season: September and October

Planting techniques

- Well land preparation and weeding
- Sowing seeds by hand
- Cover up with 2-3 cm of soil.
- Watering to keep moiture for 30 days after sowing

Management

- Watering
- Weeding
- Urea application after 10-15 days of seeding and after harvesting

Harvest

- First harvest: after 60 days and continuously after 40-50 days
- High cutting: 3-5 cm above ground level
- 2-3 cuttings/6 months

Utilization: Fresh

1.7. Elephant grass

Ecology

- Perennial, branches towards the top and grows from stem cutting nodes
- Grows on a wide range of soil types, intolerate prolonged flooding or waterlogging, grows bad in drought conditions
- Needs good moiture for production, suitable to intensive farming
- Produces best growth between 25-32^{o}C, little growth below 15^{o}C
- Production potential: 200-300 tons/ha/year
- Nutritive value: DM: 12 - 17%; **CP: 7 - 9%; edible fraction: 40 - 60%**

Fertilizer

- Organic manure: 20-30 tons/ha
- Phosphorus sulfate: 300-400 kg/ha
- Potasium sulfate: 200-300 kg/ha
- Urea: 400-500 kg/ha
- Basal fertilizing: Organic manure, Phosphorus sulfate, Potasium sulfate
- Additional fertilizing: Urea after harvesting

Planting

- Plant by stem cutting
- Length of stem: 30-40 cm/3-5 nodes
- Planting materials: 6-8 tons/ha

Planting season: plant in the rainy season, ideally from April to June

Planting techniques

- Distance between rows: 50-60 cm, row depth: 20-25 cm
- Planting: Stem cuttings are lined in two alternating rows and covered 7-10 cm of soil

Management

- Watering after planting if the soil is dry
- Check the suvival and re-plant
- Weeding
- Urea application after harvesting
- Re-planted after 4-5 years harvesting

Harvest

- First harvest: after 70-80 days and continuously after 35-40 days
- High cutting level: cut close to ground for first cutting and 5-7 cm for next cutting
- 5 to 7 cuttings/year

Utilization

Fresh or ensilaged ***(withered and chopped into small piece)***

1.8. VA-06 grass

Ecology

- Like Elephant grass
- Production potential: 200-400 tons/ha/year
- Nutritive value: DM: 14 - 17%; **CP: 7 - 10%**
- The leaf/stem is higher than Elephant grass. The leaves are green and softer. **Edible fraction: 40 - 60%**

Fertilizer

- Organic manure: 30-40 tons/ha
- Phophorus sulfate: 400-500 kg/ha
- Potassium sulfate: 300-400 kg/ha
- Urea: 450-500 kg/ha
- Fertiliser applications are similar to Elephant grass

Planting (same Elephant grass)

- Plant by stem cutting
- Length of stem: 30-40 cm/3-5 immature nodes
- Stem cutting materials: 6-8 tons/ha

Planting season:

Plant in rainy season, ideally from April to June

Planting techniques

- Distance between rows: 50-60 cm, row depth: 20-25 cm
- Planting: Stem cuttings are lined in two alternating rows and covered 7-10 cm of soil

Management

- Watering after planting if the soil is dry
- Check the suvival and re-plant
- Weeding
- Urea application after harvesting
- Re-planted after 4-5 years harvesting

Harvest

- First harvest: after 70-80 days and continuously after 35-40 days
- High cutting level: cut close to ground for first cutting and 5-7 cm for next cutting
- 5 to 7 cuttings/year

Utilization

Fresh or ensilaged ***(withered and chopped into small piece)***

Note: Elephant and VA-06 grasses have high biomass, but low quality. If Elephant and VA-06 are main roughage in the diet, the nutrient provided can not meet met the nutrition requirements. It should be combined with high quality grasses or be used for dry cows.

2. Natural grasses

Source: Riverside, roadside, dykes, common field, in between rice fields and crops

Characteristics: Can be relatively good quality (CP: 9 – 14%)

Utilization:

Grazing

Cut and carry: fresh, sun dried, hay, silage

Natural grasses can be as sole forage

Harvesting: Avoid harvesting natural grass close to water sources (lake, river, flooded field, especially where other cows defecate)

Advantages:

- Cheap (only labor cost)
- Reasonable quality

Disadvantages:

- Availability is unstable
- High risk for parasite infections
- Quality is unknown
- Labor intensive

3. Imported forages

Alfalfa hay

Imported hay from US

Characteristics :

- Grown abroad in large quantities
- Packed in bales and shipped by container to Vietnam
- Very high quality (CP=18-23%, ME=10 MJ/kg, good fiber)

Utilization: Hay, as sole forage, supplement or part of forage

- Advantages:
- Very high quality
- Ready to use
- Good choice to overcome shortage of forage in the winter

Disadvantages:

- High price
- Need to buy large quantity at once

4. By products can be used to partly replace concentrate or forage

4.1 By products as forage

4.1.1. Corn stover

Corn stover: There are 3 kind of corn stovers that depended on the harvesting time.

- Baby corn stover (CP= 10 - 12%)
- Corn stover after harvesting corn cobs for food (CP = 9 - 11%)
- Corn stover after harvesting seeds (CP = 4 - 7%)

Utilization

- Use directly for cattle (chop into small pieces)
- Silage
- Treated with 3% urea with corn stover after harvesting seeds

Note

- Quality and nutritive values of the corn stover after harvesting seed is very low!
- Whole corn (stover and cob) is good for silage

4.1.2. Rice straw

It is by product from rice production
High fibre, low protein contents (4 - 5%)

Utilization

- Can be used rice straw without any treatment with 1,5kg / 100kg body weight, especially in dry season
- **Treated rice straw with urea:** Fresh rice straw with 1,5% urea and dry rice straw (4% urea) in 2 - 3 weeks before feeding
- **Untreated rice straw** can be sprayed 1% urea before feeding
- **Sundried**
- Combine with other grass or add molasses to improve palatability

Note

Urea treatted rice traw improved nutritive value and digestibility

4.1.3. Sugar cane foliage

- By-products of sugarcane production
- Harvest and collect in winter season
- Low crude protein content (2 - 3%)

Utilization

- It can be used as a green forage to replace grass.
- It can be used to make silage. (Sugarcane contains a high sugar content that its good for silage)




Note

- Chop into small pieces before feeding
- The diet contains sugarcane foliage should be supplemented with high protein feeds

4.1.4. Cassava foliage

- Cassava foliage is a by product from cassava production
- Harvest cassava foliage 20-30 days before harvesting roots has no effect on roots production
- Contain high crude protein content (18-22%), but its contain HCN

Utilization

- Its good protein supplementation for cows
- **Sun-dried** or **silage to** reduce HCN content before feeding
- Mixed with the grasses before feeding if use as a fresh basis or when cows are hungry (not safety). The amount of cassava foliage in the roughage diet should not **exceed 25%**




4.1.5. Peanut foliage and stems

- After the harvesting of the fruits, peanut foliage are fresh → it can be used as feed for cows
- Contain high crude protein (13 - 16%)

Utilization

- It is protein source to supplement
- Mixed with grasses before feeeding, the amount of groudnut foilage should not exceed **25%** of the roughage in the diet (less than 10kg/ cow/day)
- The harvesting time take place in rainy season, the foliage are easy to spoil → should be dried or make silage

Note

If cows get **diarrhea or floating** → reduce groundnut foliage in the diet

4.1.6. Pineapple by-products

- The shoots, skin, crushed pieces of pineapple during the processing.
- High sugar and fibre contents

Utilization

- Used as forage in diet
- The maximum amount for feeding is 10-15 kg/head/day. If cows eat too much, their tongues can get hurt
- Devide into small meals for cows and combine with other feeds

Make silage

4.2. By products as concentrate

4.2.1. Brewery waste

- A by product of the beer factory
- Contains high water content, good smell and high palatability
- Contains high protein, minerals and vitamins → good for the rumen bacteria to degrade the fiber and stimulate milk production

Utilization

- 4-5 kg of brewery waste can replace 1 kg of concentrate
- Replace maximum 50% of the concentrate in the diet, the amount of brewery waste should not exceed 15 kg/cow/day
- Mixed with other feeds before feeding



Note

Can be dried for storage for a limited period

4.2.2. Molasses

- A by-product from the sugar factory
- High energy content
- Low protein content (CP = 0 - 3%)
- High palatability

Utilization

- Supplement energy in the diet
- The maximum amount for feeding is 2 kg/cow/day
- Mix with rice straw or low quality forage to improve their palatability
- Add in silage or use as ingredient of molasses urea block



Note

- Molasses are quickly fermented in the rumen which can cause a decrease rumen pH:
  - Mix with forages
  - Never dilute with water for drinking
- Low quality silage such as old corn stover should be added with molasses

4.2.3. Rice bran

- By-product of the rice processing
- Tasty and good smell → high palatability
- Quality depends on the processing and the storage

Utilization

- Use as an energy and protein supplementation
- Use as concentrate
- Use as ingredient of home made concentrate

Rice

Rice bran

Rice bran is one of material for concentrate

Note

Bad storage can lead to cause mould

4.2.4. Oil-cakes

By-product of oil extraction (peanut, soybean, cotton, sesame...)

Very high protein (CP=25 - 40%), but low calcium and phosphor contents

Utilization

- Good protein supplement
- Maximum supplementation to the cow of 1 kg/cow/day

Soya bean

Soya bean cake

Note

Store carefully to avoid mould

5. Planning forage production

5.1. Objective

- Make sure you have sufficient forage all year round
- Before making the plan of the forage production, the farmers need to calculate the forage requirements

Supply:

- Own cultivation
- By-products
- Nature grasses
- Purchased forage

Self production

Demand: = 10% of body weight

Demand and supply balance

Supply > demand → surplus

Supply < demand → shortage

By-product

5.2. An example of feed calculation:

Farm A has 3 lactating cows (live-weight of 450 kg/head) and they produce 10 tons of milk every year. The farm has 2 calves (< 12 months of age and live-weight of 150 kg/head) and 2 heifers (12 to24 months of age and live-weight of 320 kg/head). The dry period is 2 months a year. Calculate the forage requirements?

The feed requirements is calculated as follows:

Animal	FORAGES	
	Calculation	Amount (kg)
Lactating cow (3 heads)	3 x 450 x 10% x 365 =	49 275
Calf <12 months (2 heads)	2 x 150 x 10% x 365 =	10 950
Heifer 12-24 months (2 heads)	2 x 320 x 10% x 365 =	23 360
Total (7 heads)		83 585

Example: Farm B has 3 cows of 500kg. The farm has collected rice straw, corn stover equivalent to 15 tons of green forages. Calculate the land area for planting Mulato grass to meet grass requirement for 3 cows. The biomass yield of Mulato grass is 200 tons/year

Answer

- 500 kg x 10% x 3 cows = 150 kg/day
- 150 kg x 365 days = 54.900 kg (55 ton)
- 55 tons – 15 tons = 40 tons
- The land area for Mulato grass:
  40 tons : 200 = 0.2 ha

Chapter 5

BODY CONDITION SCORE AND SOME COMMON NUTRITION DISORDERS IN DAIRY COWS

1. Body condition and health status

1.1. Importance of body condition

Body condition scoring (BCS) is an improtant tool to help:

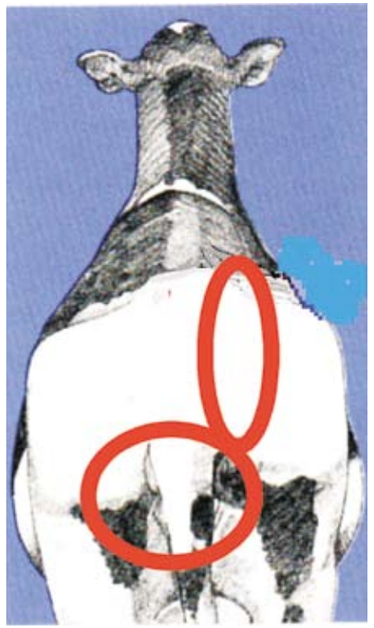
- Optimize production
- Evaluate health
- Assess nutritional status

Note

- The BCS has a strong link to the cow's health, reproduction and milk production
- Farmers can evaluate the BC of cows by visual examination and palpation themselves. Feeding regimes need to be adjusted accodingly

1.2. Objectives

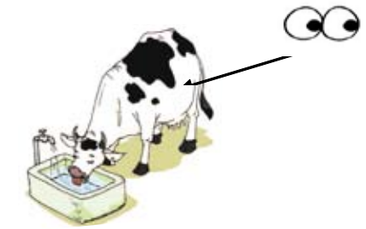
- To determine the nutritional status based on level of fat cover in anatomical points
- Proper adjustment feeding regimes
- To reduce the negative effects of thin or fat cows



Note

- The improtant anatomical points allow evaluation of the amount of muscle, skeletal features and fat cover
- There is a close correlation between the "fat cover" of the specific anatomical points and the total fat reserves
- The cows need to accumulate fat to provide energy when the energy density of the diet is lower than requirements (first stage of the lactation). But, the mobilization of too much fat for energy can be is harmful to the cow

1.3. Body condition evaluation



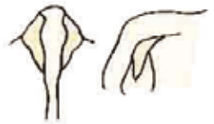
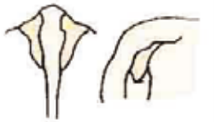
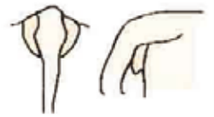
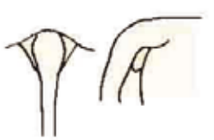
Visual evaluation

Palpate evaluation

Note

- Visual evaluation: observe the tail head, thurl, ilium (hooks), pins, short ribs, spinuos process of vertabra
- Palpate evaluation: by touching the specific points above

1.4. Body condition scores (BCS)

BCS	Spinuos process of vertabra	Rear view of the hooks	Side view form the hooks bone to pins	Cavity between tail head & pins Rear	Angle	
1						
2						
3						
4						
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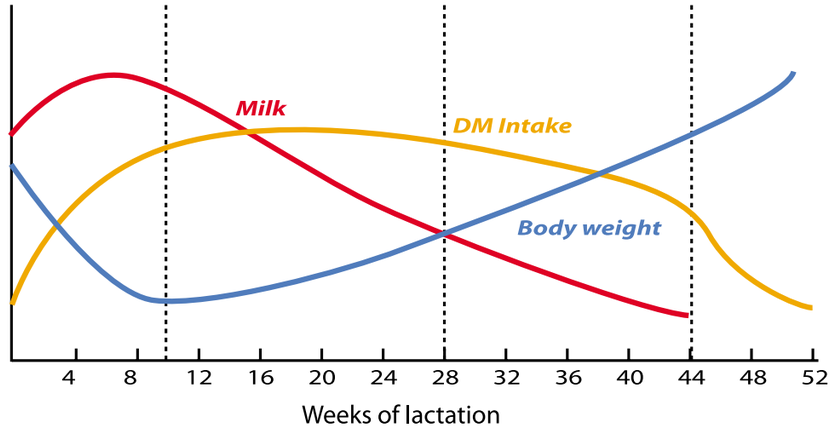
1.5. Body condition cycle



Note

The farmers should know the production cycle (see Diagram above) to make the proper adjustment to their feeding regimes to reach the optimum BCS

1.6. The optimum body condition score

The optimum body condition scores is shown in the table below:

Stage	Optimum BSC
Calving	3.25 - 3.75
Peak milk production	Decrease 0.5 to 1 of BCS compared with calving (Not below 2)
200th day of lactation	3
Dry-off	3.25 - 3.75

Note

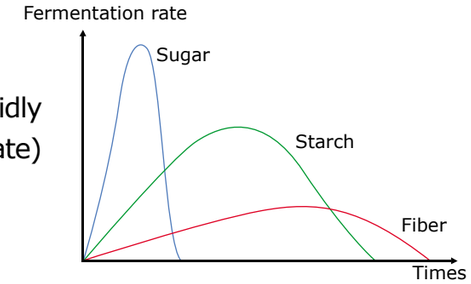
- The optimum BSC in dry-off and calving is 3.5. If cow is too thin or too fat at calving, it can be harmful to the health, reproductivity and milk production.
- If the BSC in the dry off is 3.5, the cow should not be fattened before calving.
- If the BSC decreases more than 1 score from calving to 3rd of lactation, the feeding management and feeding regimes has to be adjusted
- The thin and fat cows before calving will produce less milk than a cow with a optimum BCS
- For dairy cows, fat cows are not good for productivity and have low economic efficiency

2. Some common nutrition disorders

2.1. Rumen acidosis

Cause

- Ingest the imbalanced diet
- Ingests quickly a large quantity of rapidly fermentable carbohydrates (concentrate) (see Diagram)



Symptom and consequense

- Indigestible feeds
- Bloating
- Reduction in milk production
- Depressed fat test
- Laminitis and abomasal disorders

➡ **In severe cases, the cow may die**

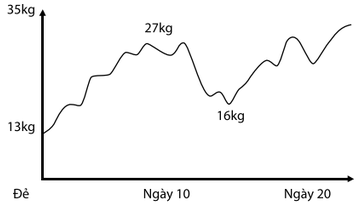
Prevention

- Increase the fiber to balance the diet
- Feed concentrate gradually and mix forage and concentrate
- Supplement $NaHCO_3$ at the rate of 0.5 - 0,75% to the concentrate

2.2. Ketosis (Acetonemia)

Cause

In early lactation, high productive cows mobilize too much body fat from the reserves to produce milk



Symptom

- Refuse to eat, weight loss and eyes-hollow
- **Drop in** milk production (see Diagram)
- Acetone exhalation (bad smell)
- Strange behavior, depression, staggering and panic

Prevention

- Control BCS before calving (BCS<4)
- Provide good quality of forage, high energy density, palatability and balanced diet after calving

Note: Call the Vet

2.3. Milk fever (Hypocalcaemia)

Cause

- Shortage of calcium
- The diet for cow in dry period are rich of Ca
- The mobilization of Ca from body reserves such as bone or absorption of Ca does not respond physiologically promptly to meet with requirements depending upon the previous Ca status during dry period

Symptom

- Unable to stand, weak muscles, paralytic after parturition
- Abnormal rise in body temperature
- Drop in milk production

Prevention

- Reduce Ca and P contents in the diet from 7-10 days before calving
- Injection vitamin D from 7-10 days before calving
- Let cow exercise and sunbath before the calving

Note: Call the Vet

2.4. Bloat

Cause

- The cow eats feed that contains resin (high gas production)
- The cow consumed the plants which contain high levels of rapidly ruminally degradable protein and cacbonhydrate
- The feeds contain antinutrition and toxin

Symptom

- Too much gas in the rumen
- The rumen is bloated, difficulties to breath
- In severe cases the cow can die

Intervention

- Use gastric fistula through the esophagus into the rumen to release gas
- Drenching to destroy the gas film by proxalene through the gastric fistula
- Use troca through the wall of the rumen (call for vet.)

Note

Other causes of bloat can be:

- The cow is poisoned and can not eructate
- The esophagus or the pharynx is obstructed
- Other infectious diseases

2.5. Urea poisoning

Cause

- The cows consume too much urea (urea is not mixed thoroughly with feeds or urea is dissolved in water for drinking)

Symptom

- Occurs 20-30 minutes after eating of urea
- Gasping
- Shivering and staggering
- Can not stand
- Muscles are shriveling

Prevention

- Well-mixed urea with other feeds
- Introduce urea gradually
- Never feed urea when cow are hungry
- Never offer of mix urea-high palatability feeds to the hungry cows
- Never dissolve urea in water for drinking
- Never add urea in the diet for calves

Treatment

- Use vinegar, preserved-vegetable fluid or acetic acid 5%.
- Provide cool water

Note: The amount of urea should not exceed 90gr/head/day

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