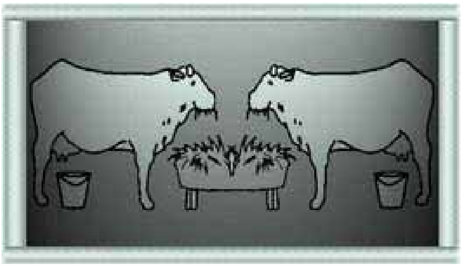

Small-scale

dairy farming manual

Vol. 3

Regional Dairy Development and Training Team
for Asia and Pacific
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Regional Office for Asia and the Pacific
Bangkok, Thailand

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
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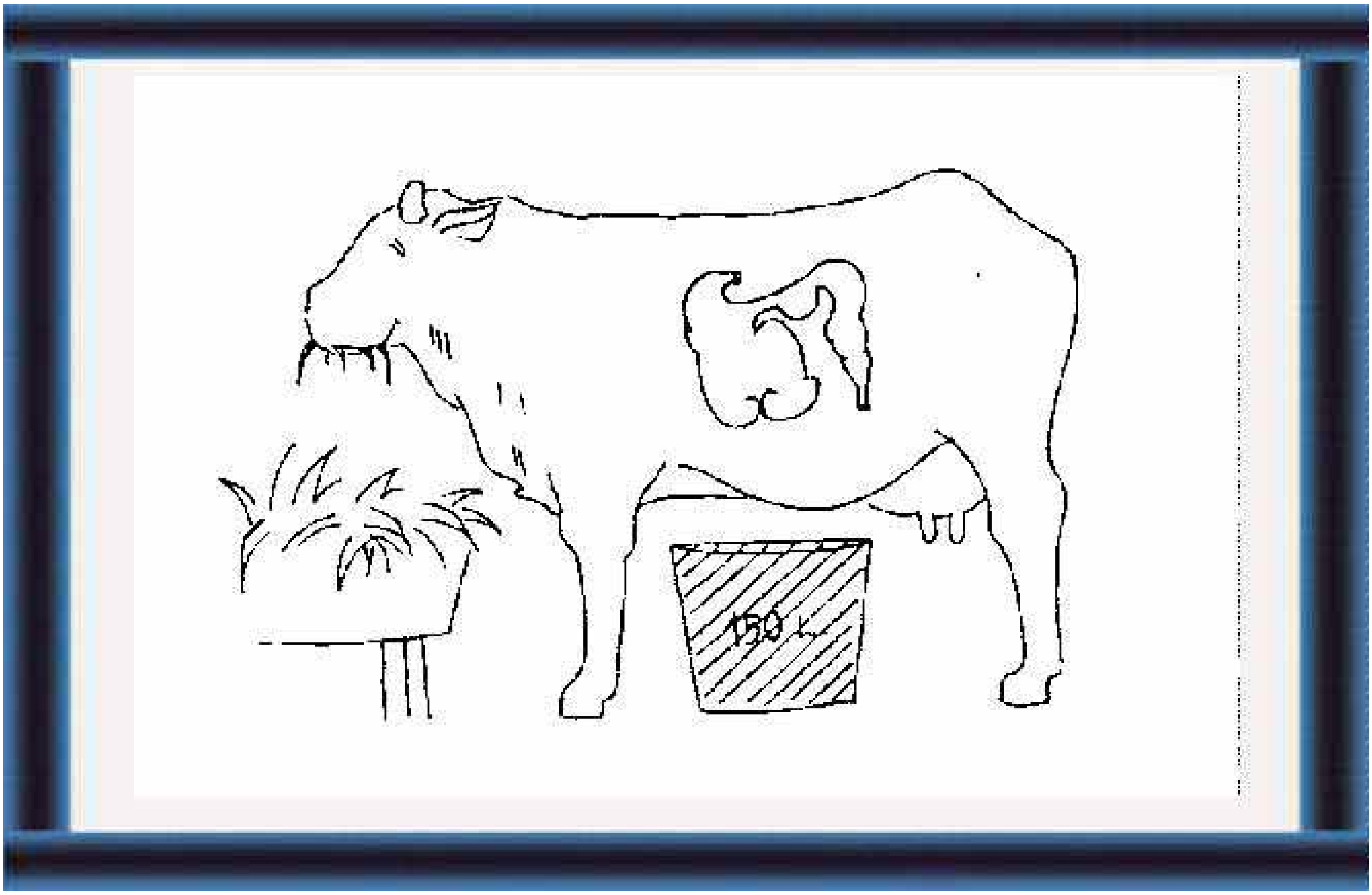


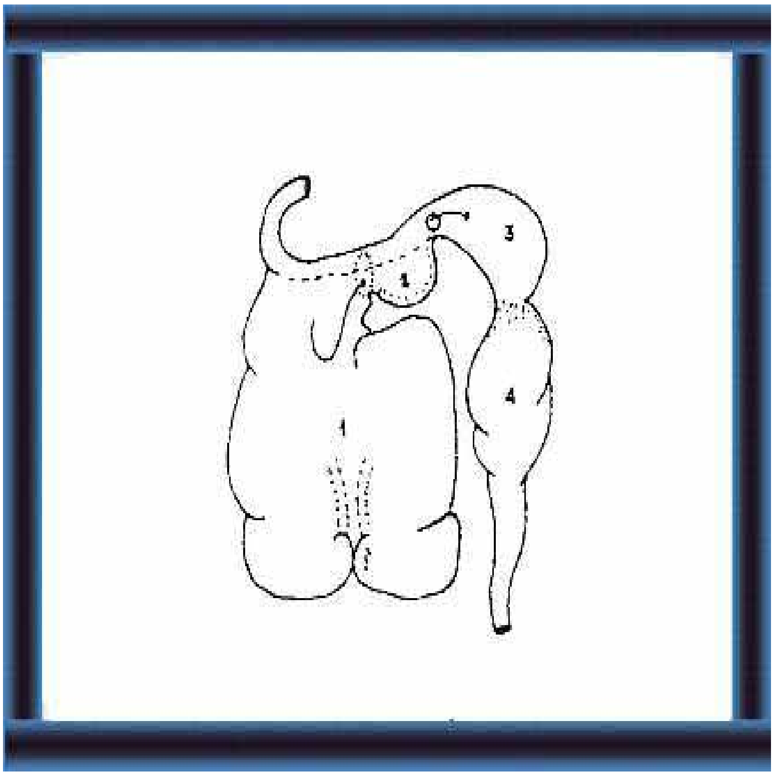
Extension Materials

What should you know about feeding dairy cattle and buffalo?

What is important in feeding dairy cattle and

buffalo? (5-16)

1 Feeding the **right amounts** of:
- proteins
- carbohydrates and fats
- minerals and vitamins.



How do dairy cattle and buffalo digest feeds? (17-28)

2 By having a **special stomach** with 4 parts.

What type of feeds are there and what is their value? (29-51)

3 There are:
- roughages
- concentrates
- mineral and vitamin supplements.

How much feed do dairy cattle and buffalo need? (52-91)

4 This depends on:
- their **body weight**
- what they **produce**.

FEEDING DAIRY CATTLE & BUFFALO

Husbandry Unit 4:

Technical Notes

Note: Numbers in brackets refer to illustrations in the Extension Materials.

Introduction (5-8)

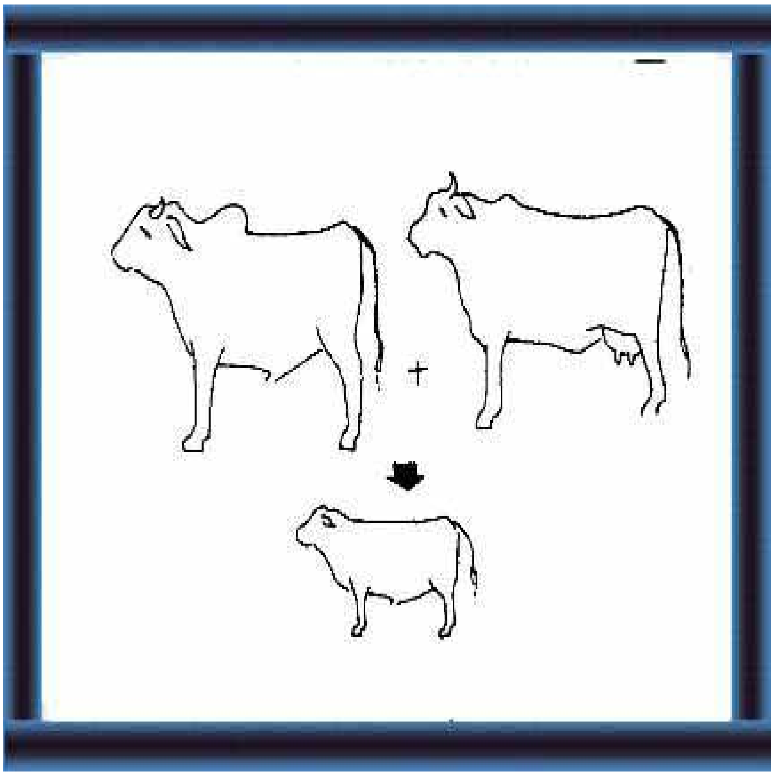
There are large cattle and buffalo populations in the Asian region. In most countries the indigenous stock is mainly used for draught and meat. However, in India and Pakistan some indigenous breeds have been selectively bred for improved milk production.

In most of the countries in the region, programmes have been undertaken for the crossbreeding and upgrading of the indigenous cattle with temperate breeds to obtain higher milk production. Some countries have resorted to large scale importation of pure-bred temperate cattle for the same purpose.

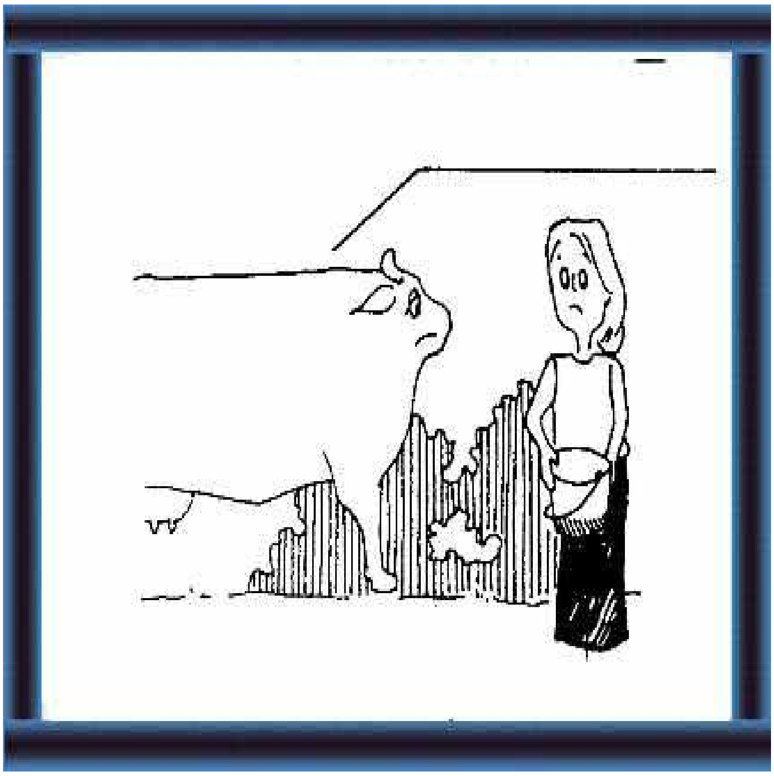
It is observed, however, that adequate attention is not being given to proper feeding of dairy animals. Thus they are not producing what they could (i.e. the full genetic potential for milk production is not expressed). This is shown by the higher levels of production in well managed herds than in poorly managed herds with the same type of animals.

Adequate attention, therefore, should be given to the proper feeding of dairy animals to obtain best results.

What is important in feeding dairy cattle and buffalo?



5 For **high** milk production **good feeding** must go together with **good breeding**.



6 Even a good temperate breed e. g. Friesian gives **low** milk production with **poor feeding**

7 whereas crossbreeds or selected local breeds can give **good** milk production with **good feeding**.

8 **Good feeding** gives you **more milk** which you can sell for **more money**.

Nutrients from feeds (9-16)

Dairy cattle and buffalo, like humans and all other animals, need food to obtain the various nutrient requirements for their proper functioning. (The roles played by the combined action of the various nutrients are too complex to be discussed in detail. Only important practical aspects are considered here to make the farmers aware of their importance.) The nutrient requirements can be thought of in a simplified manner as follows.

- Bones, which give the body its structure, provide attachment points for the muscles and make it possible for easy move-ment from place to place, are made of minerals. (Minerals are also required in certain varying amounts for proper functioning of the body.)

- Muscles, which make it possible for one organ to move rela-tive to others and for the animal to move from one place to another, are made mainly of proteins. (Proteins can also be used as a source of energy, but the main requirement is for body building and repair functions.)

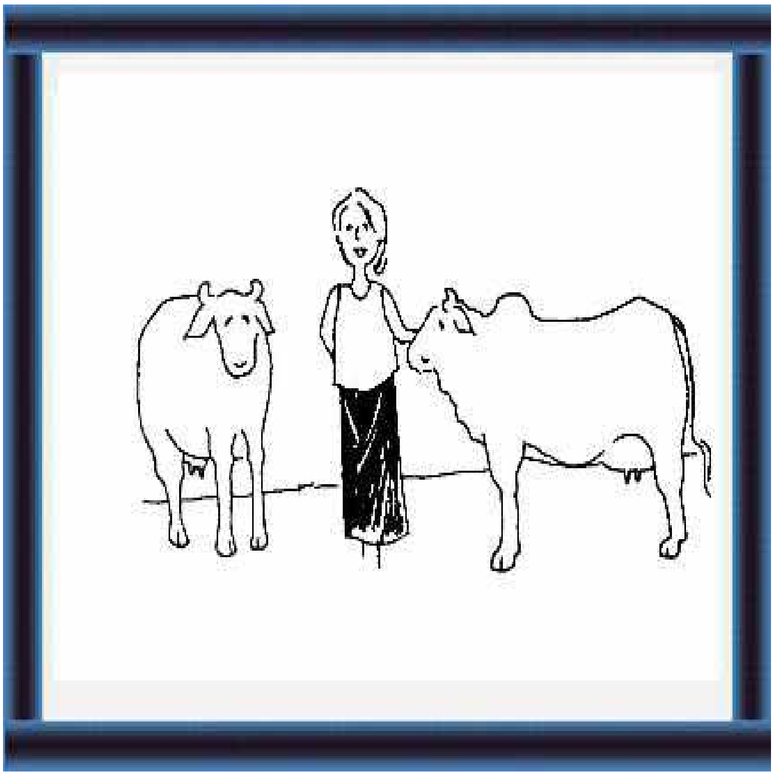
- Energy, which is necessary for the various body functions (energy for running an engine is obtained from the fuel that it burns) comes mainly from:

 - Carbohydrates

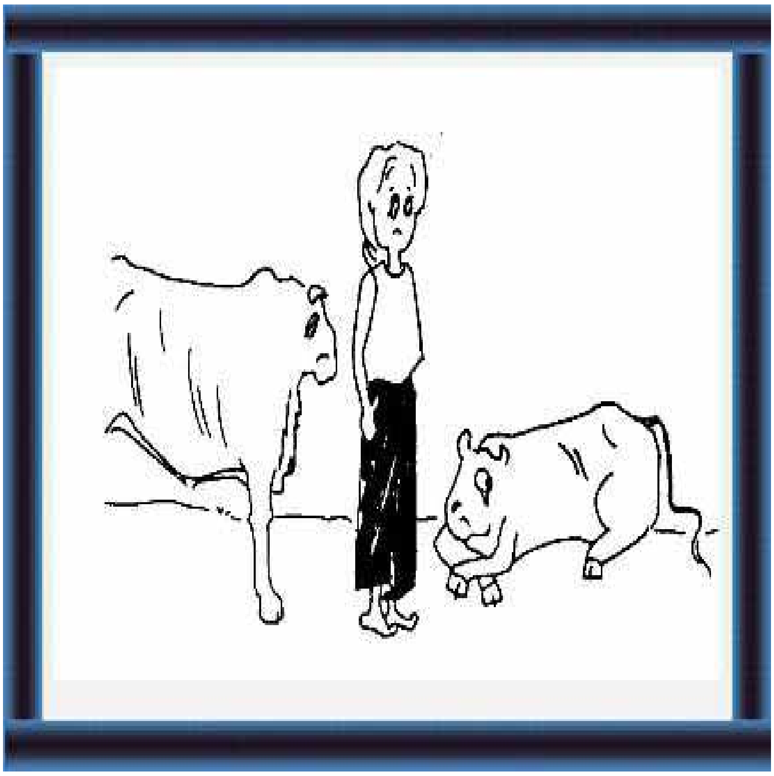
 - Fats. (These are stores of energy and also form part of the connective tissue which bind organs together.)

- Activation of various metabolic activities in the body require the presence of vitamins. These are required in minute quantities and may be compared to the lubricating oils in an engine.

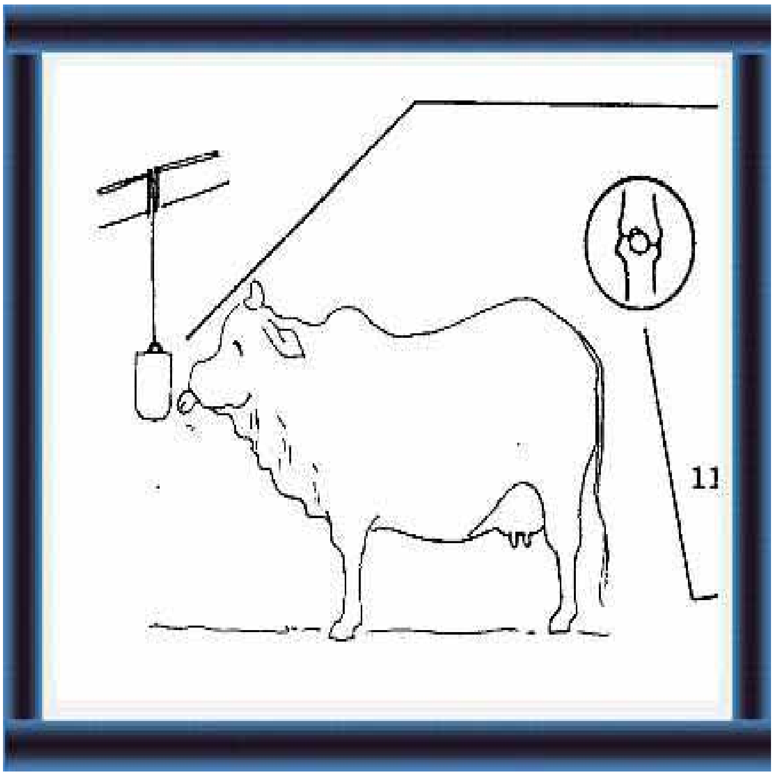
Whereas animals require these nutrients in a ready made form which can be digested and utilized by them, plants can manufacture these nutrients from air, water and soil nutrients with energy from the sun.



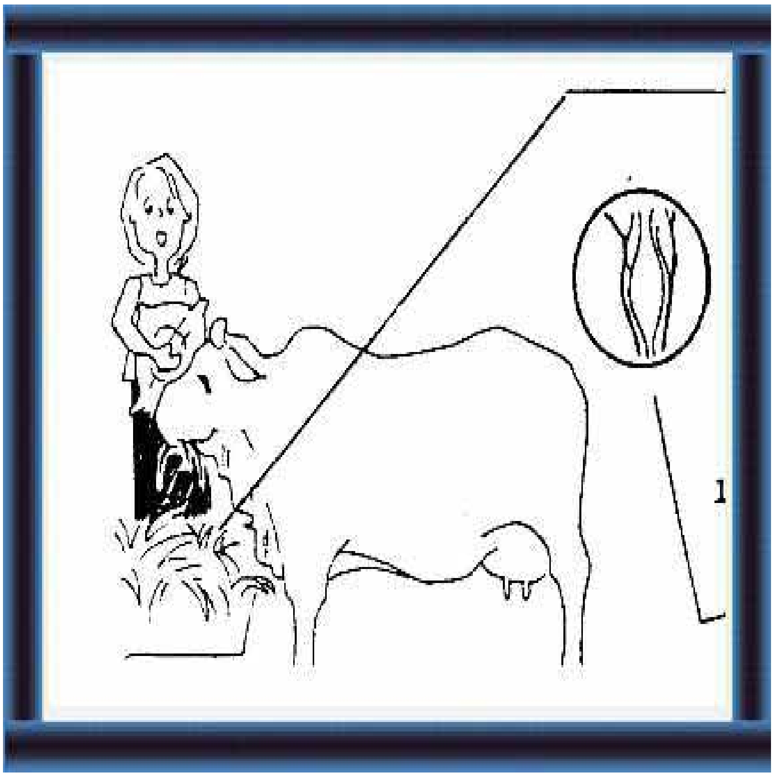
9 Your animals need **nutrients** from feeds to be **strong** and **healthy**.



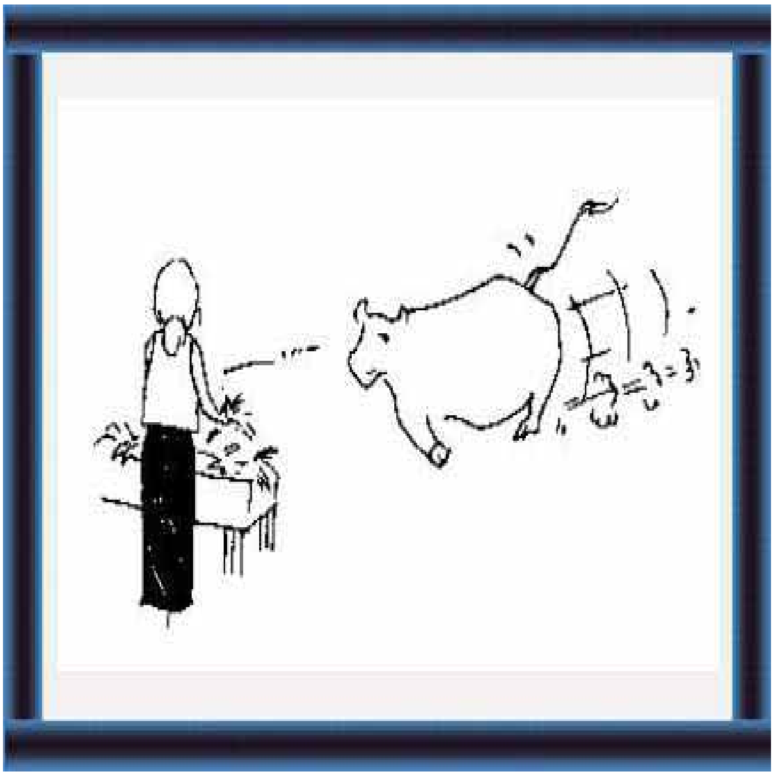
10 If some **nutrients** are **missing** your animals:
- become **weak** and get **disease**
- produce **less**
- may **not** become pregnant.



11 Your animals **need minerals** for strong bones and joints



12 and **proteins** to build strong muscles.



13 They need **carbohydrates** and **fat** for **energy**

14 and **vitamins** so their bodies can **work properly**.

15 Plants can **make** these **nutrients** from the air, soil, water and with energy from the sun.

16 Animals **cannot** make nutrients, unless you feed the **right amounts** of the **correct feeds**.

The Ruminants (17-28)

Cattle and buffalo belong to the group of animals referred to as ruminants. These animals have a "complex" stomach comprising four different compartments, which enable them to utilize various roughages efficiently and to obtain nutrients from them.

The four compartments are rumen, reticulum, omasum and abomasum. The abomasum is the true stomach and is comparable to the "simple" stomach of the non-ruminants. The other three are the "fore" stomachs.

At birth the calf resembles a non-ruminant because the "fore" stomachs are not developed. Thus the calf requires milk or milk replacers and calf starters in its early days of life. During this early period, milk gets directed into the abomasum, without passing through the "fore" stomachs, by a special mechanism.

As the calf grows it starts to nibble grass (or hay offered to it) and the "fore" stomachs become functional rapidly. Thereafter, the food taken by the animal first enters the rumen. Here the digestive process starts (before reaching the abomasum).

The capacity of the "fore" stomachs is about 13-14 times that of the abomasum. In adult cattle/buffalo, the rumen alone may have a capacity of up to 150 litres. Thus they can consume very large quantities of roughages.

Within the rumen are billions of micro-organisms, both bacteria and protozoa. These micro-organisms initiate the process of digestion by:

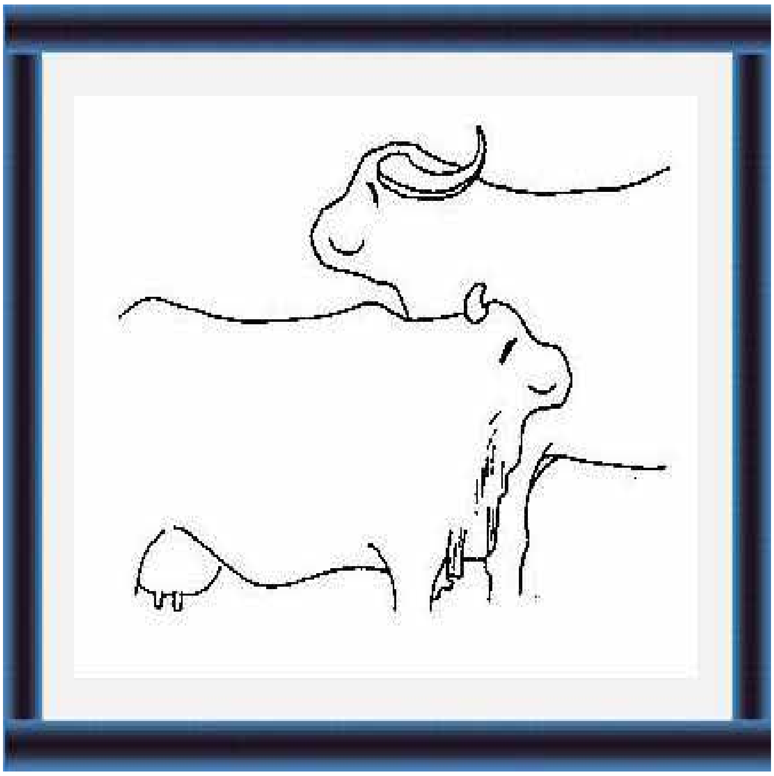
- converting the carbohydrates (e.g. sugars, starches, cellu-lose etc) to volatile fatty acids (VFA);

- breaking down the proteins into amino acids and even further into ammonia, carbon dioxide and VFA; and

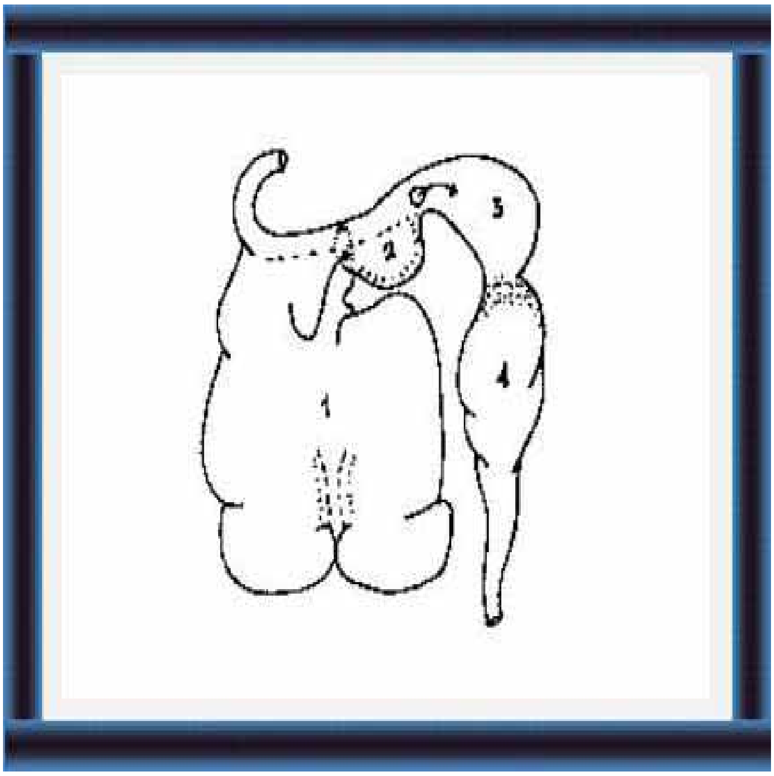
- forming new amino acids (including the "essential" amino acids) and more proteins by multiplying themselves. (The bodies of the micro-organisms contain proteins; more pro-teins are formed when they multiply; the proteins are made of amino acids - both essential and non-essential.)

The micro-organisms also produce (synthesize) vitamins of the "B" group, which are absorbed and utilized by rumi-nants.)

How do dairy cattle and buffalo digest feeds?

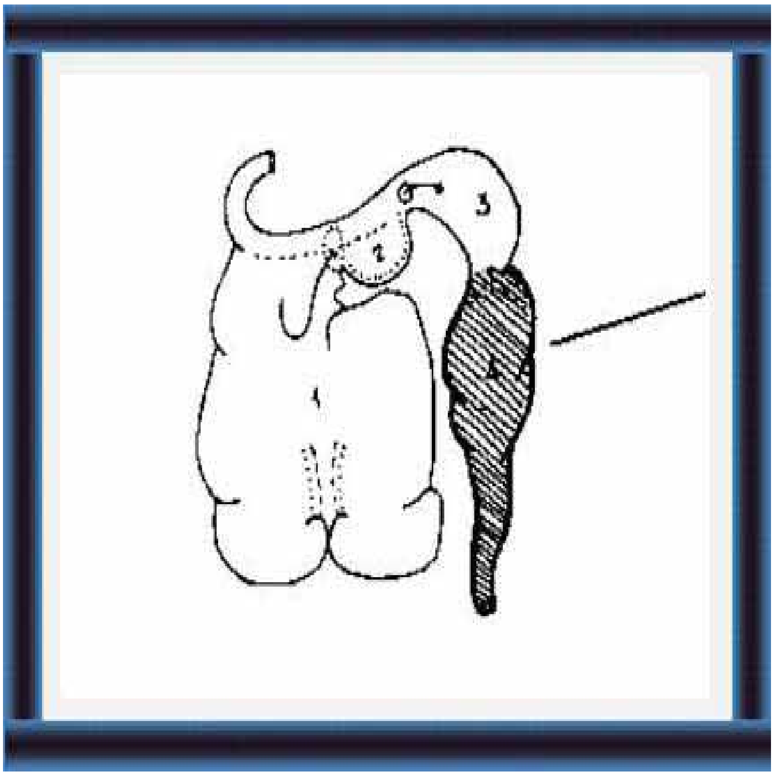


17 Cattle and buffalo are called **"ruminants"**

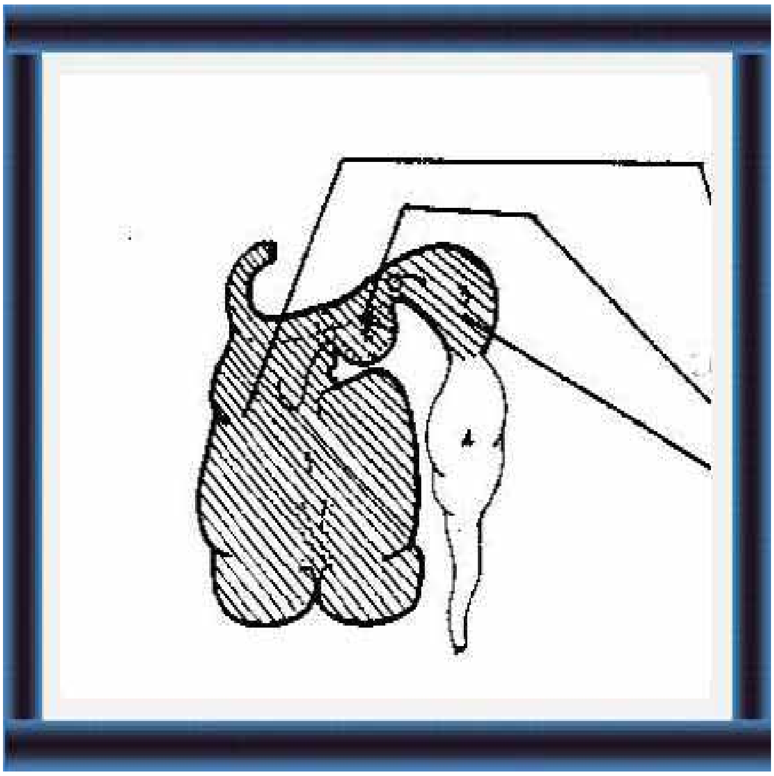


18 because their stomach has **4 parts**.

With this complex stomach, they can get **nutrients from roughages**.



19 The **abomasum** is the **"real"** stomach and is similar to your stomach.



20 The other 3 stomachs
- rumen
- reticulum
- omasum

are the **"fore"** stomachs.

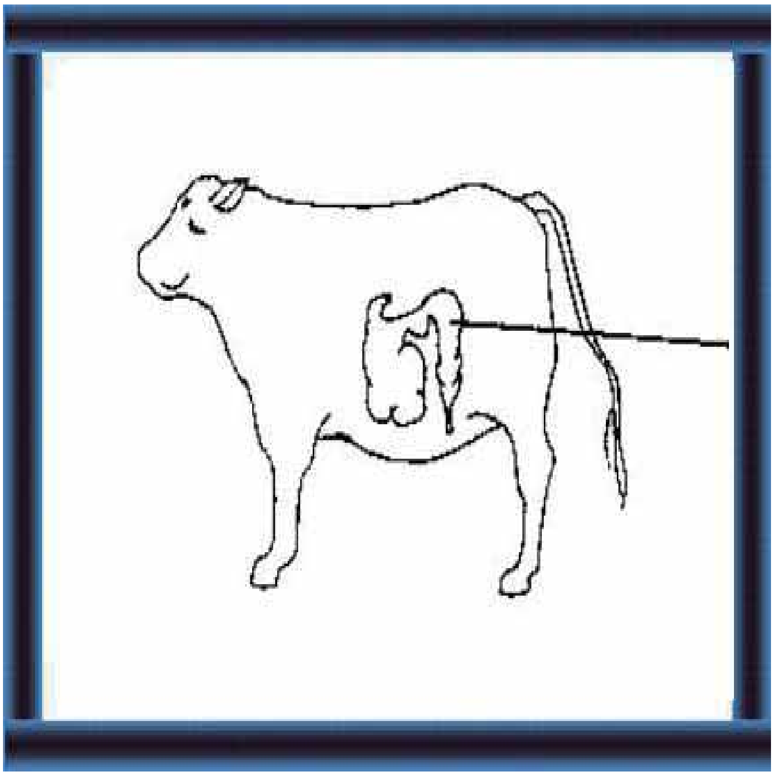
The most important features of the ruminant digestive process are:

- the ease with which roughages are converted into VFA, which are then absorbed and utilized by the animals as a source of energy (and production of fat); and

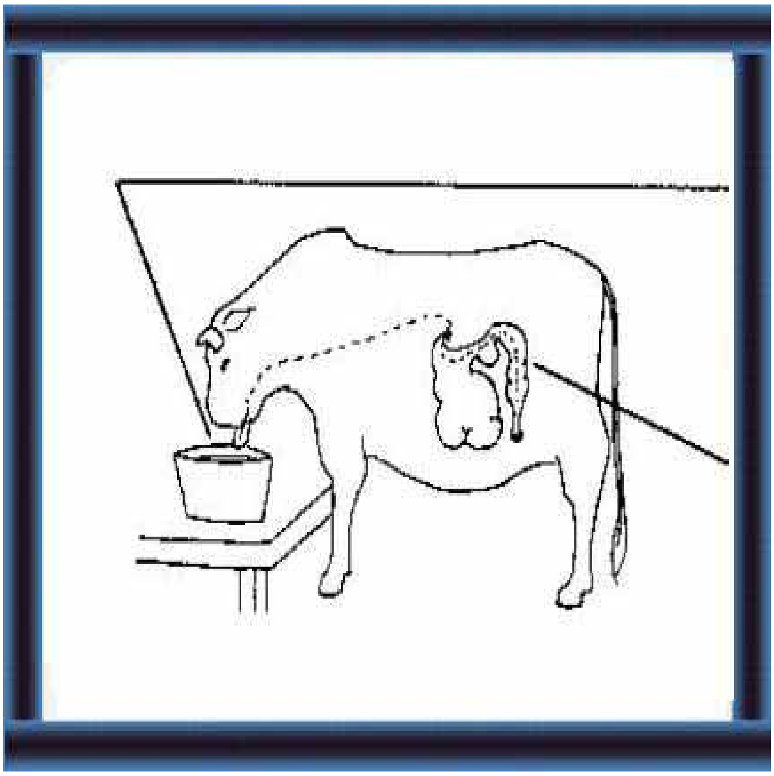
- the formation of essential amino acids (or proteins contain-ing them, which are broken down into the respective amino acids in the abomasum) from non-protein nitrogen sources e.g. urea and proteins which do not contain any essential amino acids. The amino acids are subsequently absorbed and utilized to form proteins or as a source of energy.

Therefore, to make dairying economical, feed buffalo and cattle appropriate quantities of:

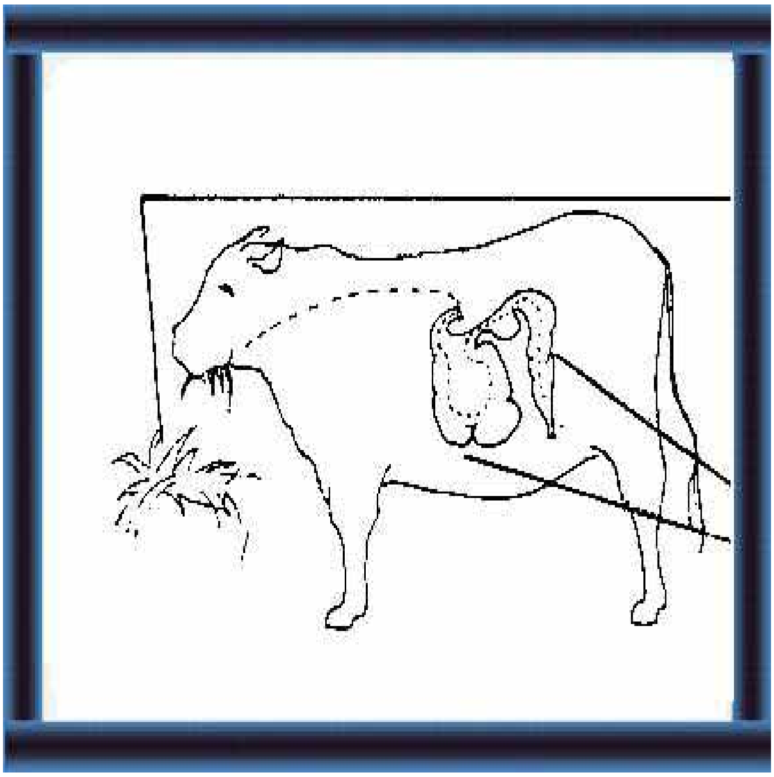
- roughages
- protein supplements (with poor quality proteins) and
- non-protein nitrogen sources.



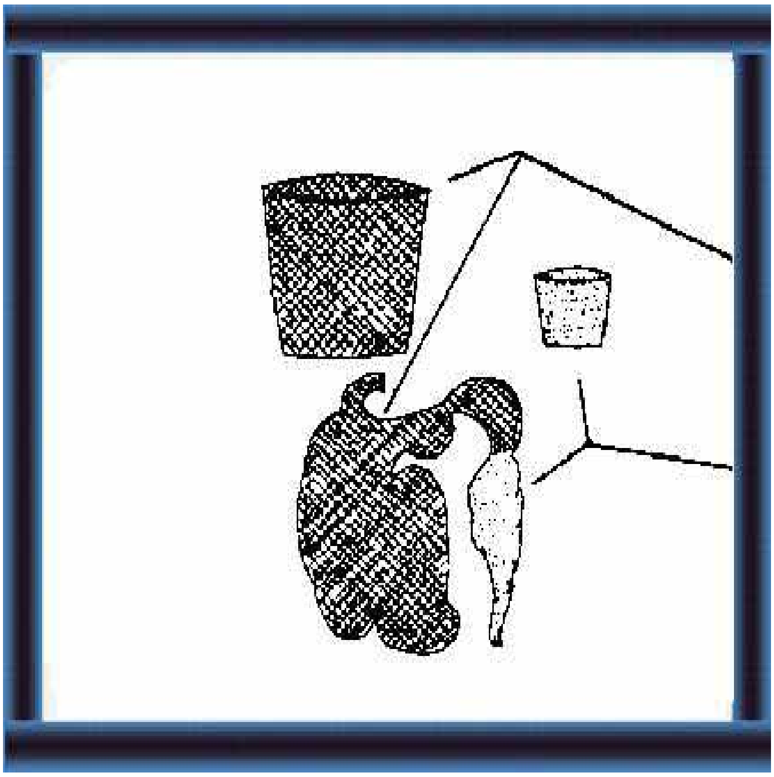
21 At birth, your calf has a stomach like yours.
The **"fore"** stomachs are **not developed**.



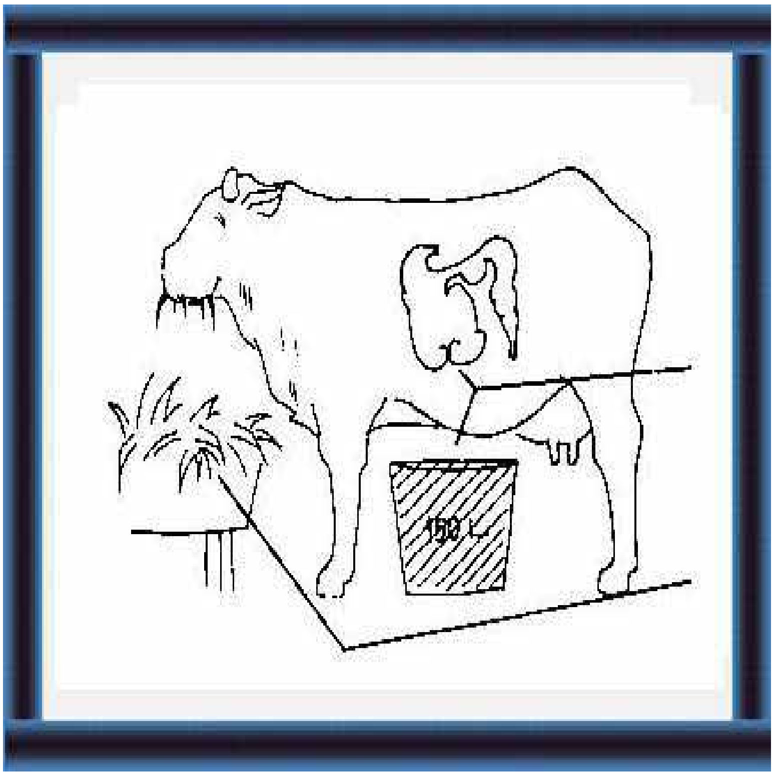
22 So your calf **needs milk** and **milk replacers**.
They go **straight to the abomasum** without entering the "fore" stomachs.



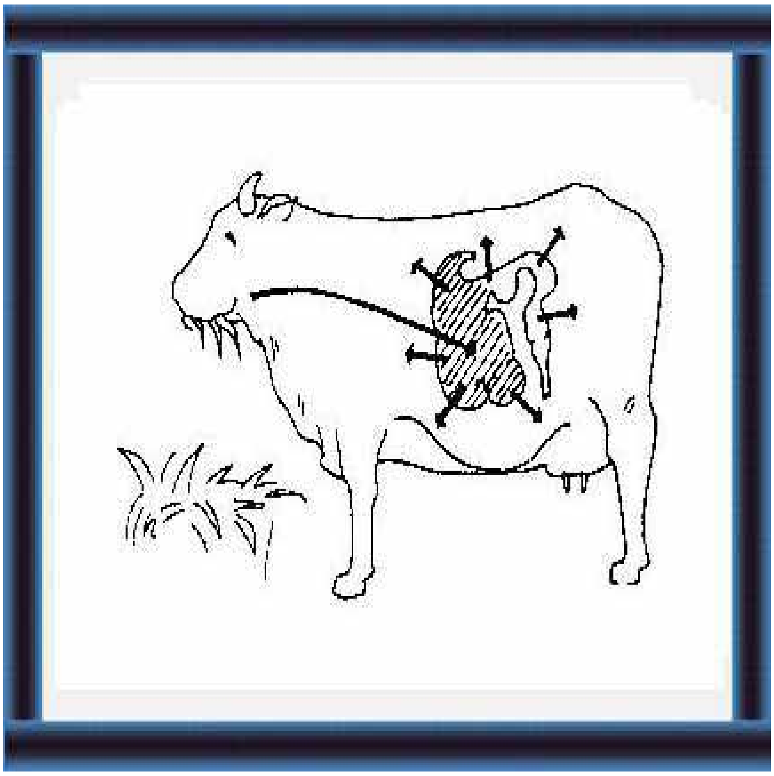
23 As your calf grows, it feeds on grass and hay.
The food enters the "fore" stomachs before passing to the abomasum.



24 The "fore" stomachs can hold **13-14 times** as much as the abomasum.



25 The "fore" stomachs of your adult animals can hold **up to 150 l**.
They can consume **large amounts of roughages**.



26 The **rumen** contains a great number of **micro-organisms** which help to change roughages into useful nutrients.

27 To **save money** but still have **good milk production**, feed the **right amounts** of
- roughages

28
- protein supplements (with poor quality proteins)
- feeds with non-protein nitrogen.

Types of feed (for ruminant feeding) (29-40)

A simple way of classifying feeds is to group them as roughages, concentrates and mineral supplements.

- Roughages are feeds with a high fibre content. These include grasses, fodders and legumes - either in the fresh state or in preserved forms such as hay or silage; leaves of trees (tree fodders) and crop residues (see H.1), which can be fed as they are or after treatment to improve the nutritive value e.g. urea treated straw (see H. 5.4).

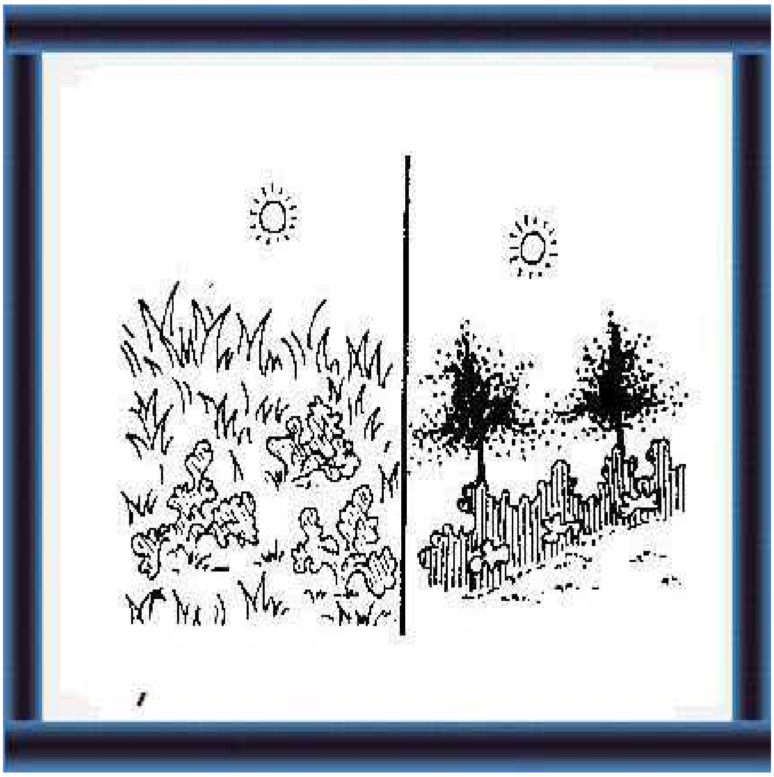
- Concentrates are characterized by a higher dry matter content and a higher digestibility. They can be of plant origin or animal origin. Some of them contain significant amounts of one or more minerals.

Mineral supplements are usually available in the form of powders to be offered with the concentrates and in the form of blocks to be offered as licks. They contain varying combinations of minerals. An ideal mineral supplement should supply the shortfall between the animals needs and what is available in the feed it receives.

What types of ruminant feed are there?

29 There are **three** main types of feed.

Roughages
Roughages are feeds with a **high fibrecontent**.



30 They include:
- grasses
- fodders
- legumes
either **fresh**

31 or **preserved** as
- hay (See H. 5.3)
- silage (See H. 5.4)

32
- leaves of trees (tree fodders) (See H. 5.2)
- crop residues (See H.1)
either **fresh**

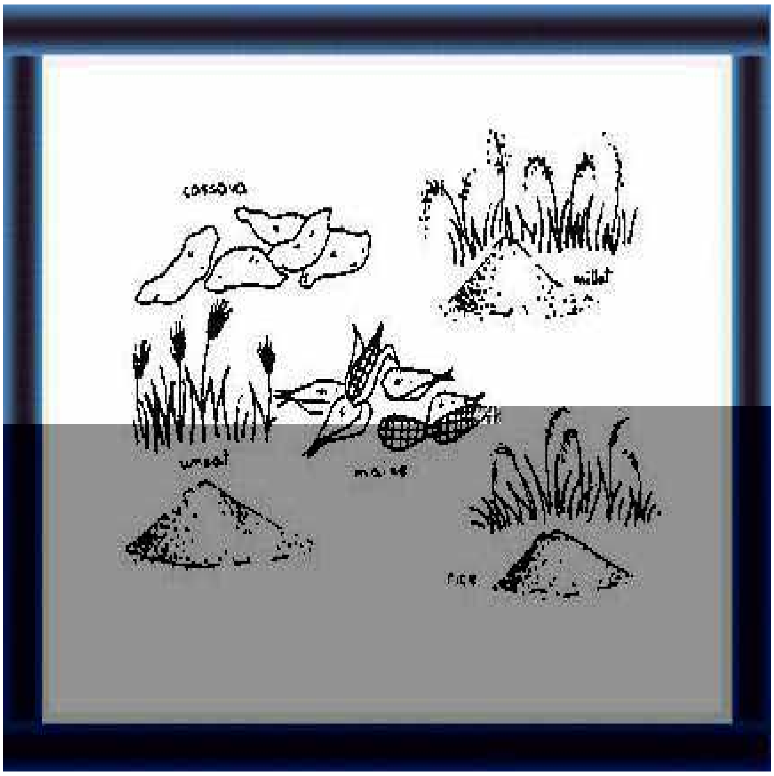
33 or **treated** to **improve the nutrient value** e.g. urea treated straw (See H. 5.5).

Concentrates

34 Concentrates are feeds with a **higher dry matter** content and a **higher digestibility**.

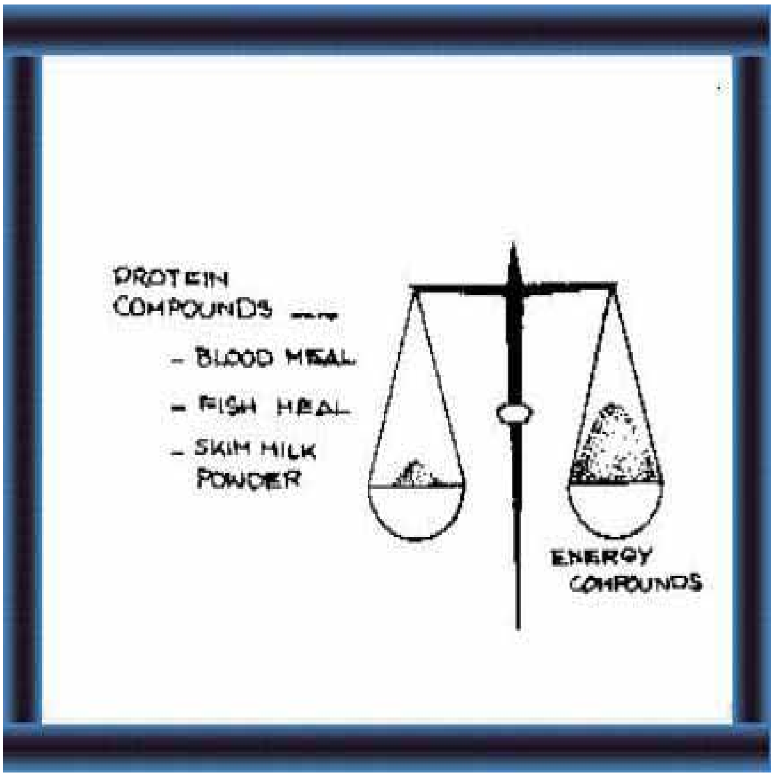
Plant concentrates

There are two types of concentrates which come from **plants**.



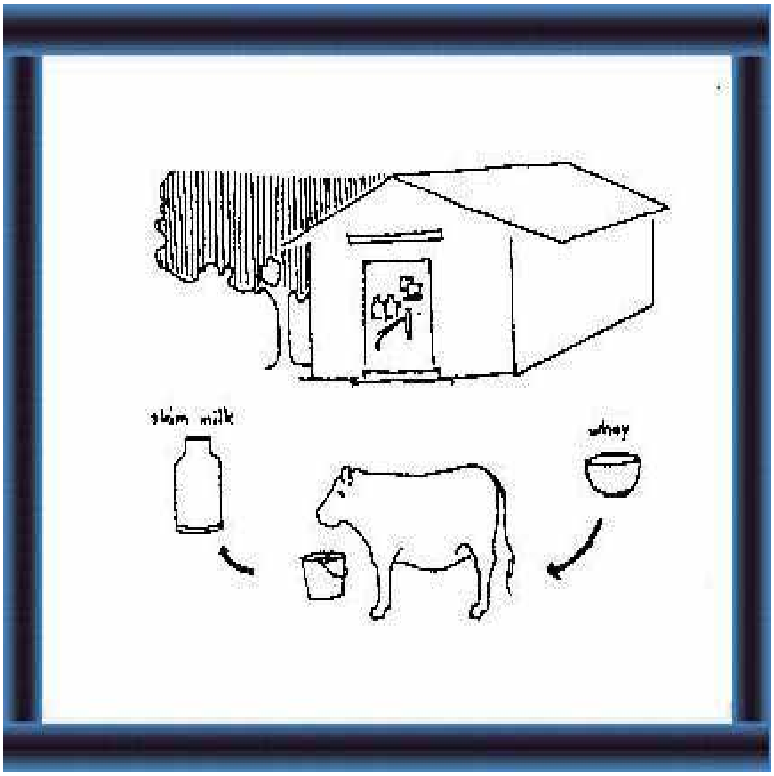
35 **Energy-rich concentrates**
These include:
- dried cassava tubers
- cereals e.g. rice, wheat, maize, millet, sorghum
- agricultural by-products e. g. rice bran, wheat bran, molasses.

36 **Protein-rich concentrates**
These include residues after you remove oil from vegetable products e.g. cakes or meals.



Animal concentrates

37 Concentrates which come from animals have **more high-quality proteins**.

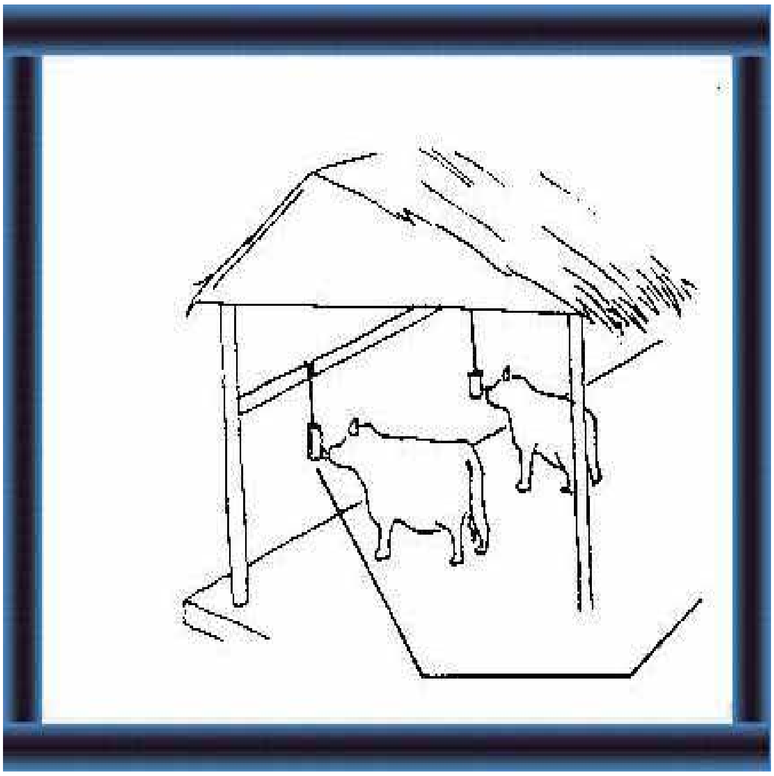


38 They include by-products from milk processing e.g.

- skim milk
- whey

for calf feeds.

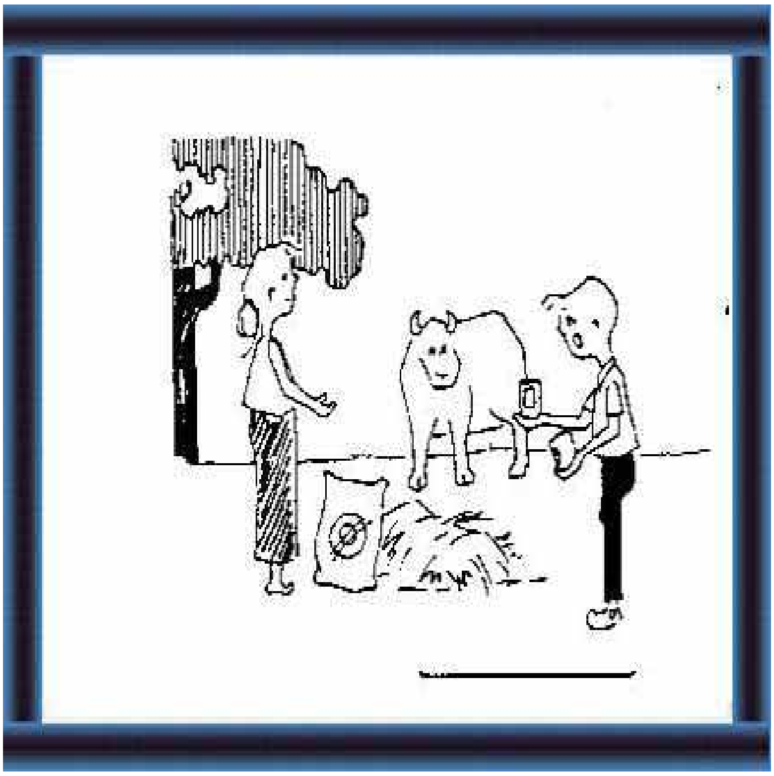
These are too expensive for adult animals.



Mineral supplements

39 The roughages and concentrates contain **most** of the minerals required by cattle and buffalo.

Supplements are necessary where the quantities in the feed **fall short** of requirements.



40 A good mineral supplement should **make up** for the **shortfall** of minerals in feeds.
Consult your extension worker about this.

Feed quality

The value of a feed depends on:

- How much of the intended product (e.g. milk, work, meat) is produced with a unit quantity of the feed.

- How much of it will be consumed by an animal (feed intake).

It is not easy, however, to establish such a relationship because the final outcome depends on a combination of feeds and many other factors (e.g. the animal's potential for production, the environment, management practices etc.).

A simpler way to evaluate the quality of a feed is to determine the quantity of nutrients that can be digested and absorbed from a given quantity of the feed. Even this is not easy to carry out, because it involves:

- analysis of a sample of the feed in a laboratory to determine its composition, and

- tests to determine the digestibility of each component.

However, in most countries, data is already available on the nutritive value of at least the more important feedstuffs. It is very important to remember that the nutritive value of any particular feedstuff can vary, depending on a large number of factors. Some examples are:

- the same grass grown in different locations may have differ-ent nutritive values depending on:

  - climatic conditions and season e.g. rainfall, environmental temperatures, elevation above sea-level etc;

  - soil fertility and fertilizer application;

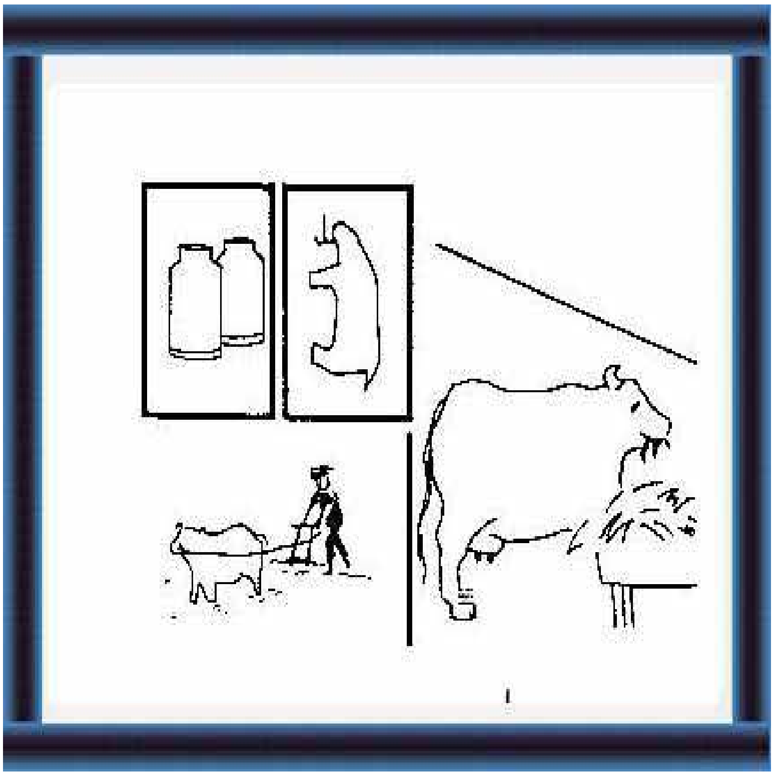
  - stage of growth etc.

- hay or silage made from the same plot of grass may have different nutritive values depending on the process of hay making, ensiling etc;

- rice bran from different mills or from the same mill at different times may have different nutritive values.

Therefore, the extension officer should be aware of the different feedstuffs available to the farmers in his area, and consult the appropriate research institute or authority to obtain information on the nutritive values of these feedstuffs.

How can you find the value of feeds?



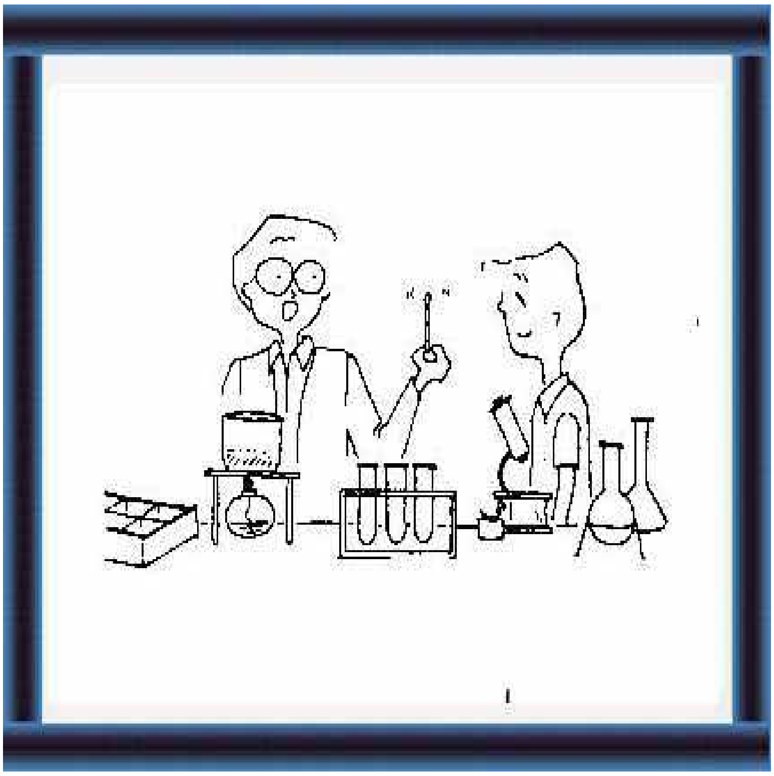
41 The value of a feed is

- what your animal **produces** (e.g. milk, meat, work) in **relation** to

- what your animal **eats** (feed intake).

42 The value of feeds depends on **many factors**:

- type of feedstuff and variety of plant
- climate
- stage of growth
- type of processing.



43 Laboratory analysis gives the value of feed.
After a lot of laboratory analysis, estimates of feed value are usually available.

44 Consult your extension worker for advice on the value of different feeds.

Total digestible nutrients (TDN)

In the Asian region, the nutritive values of cattle/buffalo feeds are usually expressed in terms of the TDN, DCP and the content of important mineral elements in 100 g of the feedstuff (i.e. as a percentage).

- TDN (Total Digestible Nutrients) is a measure of the amount of energy that can be obtained from a unit quantity of the feed. A particular feed with 60 % TDN contains 60 g of TDN in 100 g of the feed or 600 g of TDN in 1 kg of the feed.

- DCP (Digestible Crude Protein) is a measure of the amount of protein in the feed that can be digested and absorbed by the animal. A feed with 20 % DCP contains 20 g of digestible crude protein in 100 g of the feed or 200 g of digestible crude protein in 1 kg of the feed.

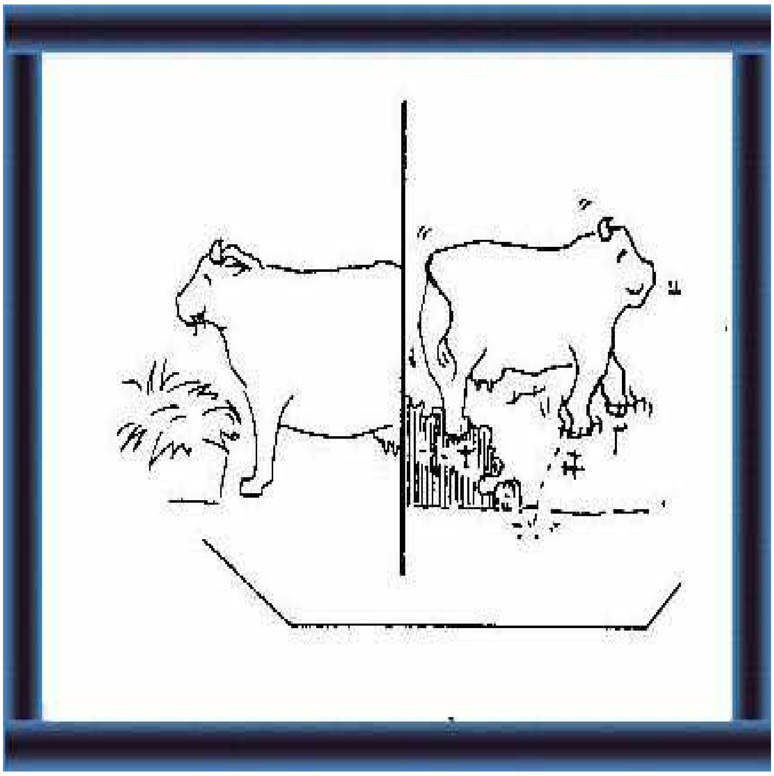
- The amounts of important minerals contained in the feeds are also usually indicated in terms of a percentage. Thus a feed with 1 % Phosphorus contains 1 g of Phosphorus in 100 g of the feed or 10 g of Phosphorus in 1 kg of the feed.

The DM (Dry Matter Content) of a feed, e.g. grass, can vary widely. Thus the nutritive values expressed in terms of 100 g of grass, for example, may not be meaningful. Therefore, the nutritive value is usually expressed in terms of a percentage of the DM in the feed. However, it is sometimes expressed as a percentage of the whole feed. The DM percentage is also indicated to make the necessary computations.

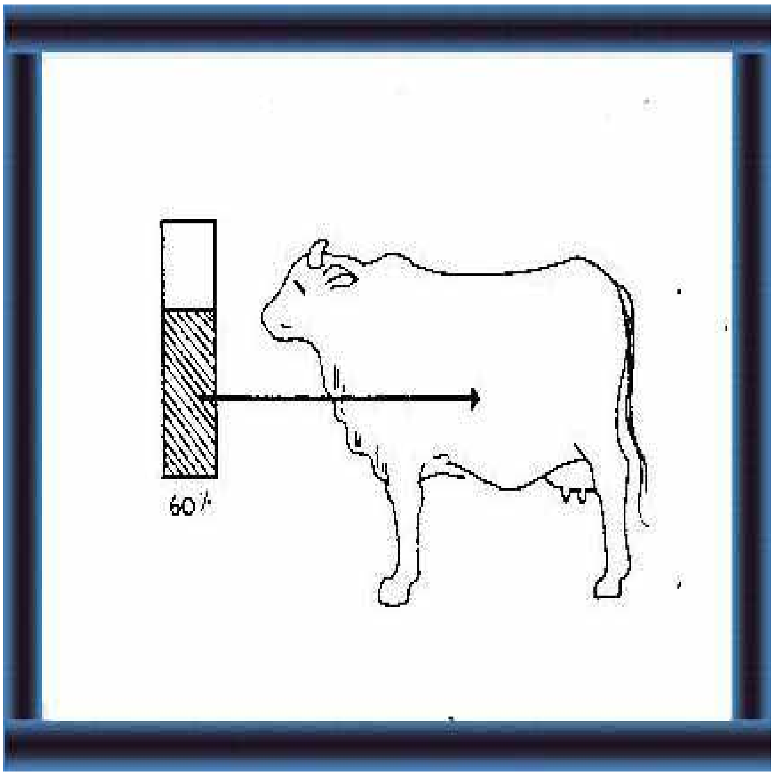
The extension officer should:

- have a clear understanding of these differences; and

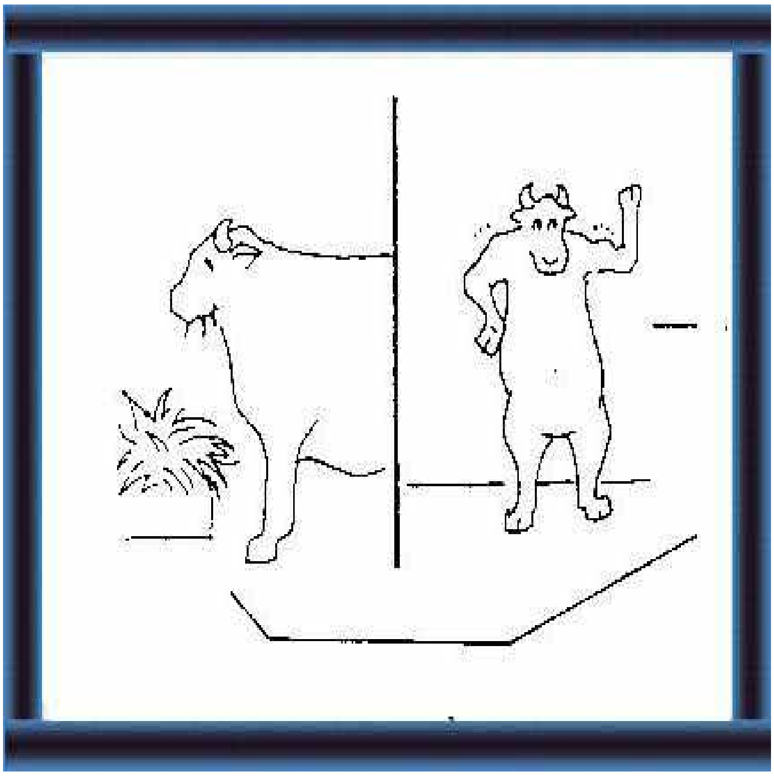
- make the appropriate adjustments in computing the nutritive value of the feeds available to farmers.



45 TDN tells you **how much energy** your animals can get from a feed.

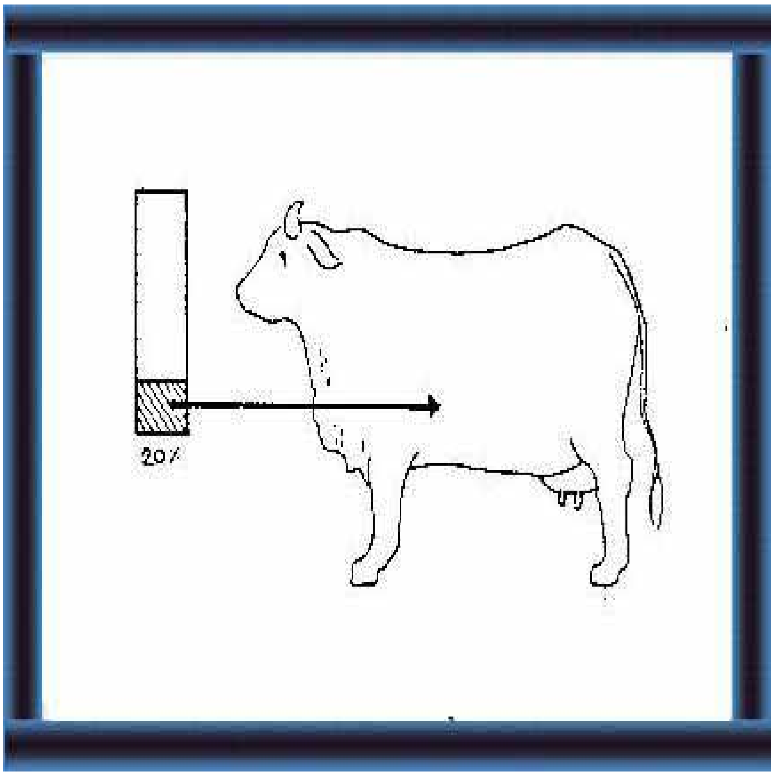


46 If your feed has **60 % TDN** your animals can get **600 g TDN** (of energy) **from 1 kg of feed**.

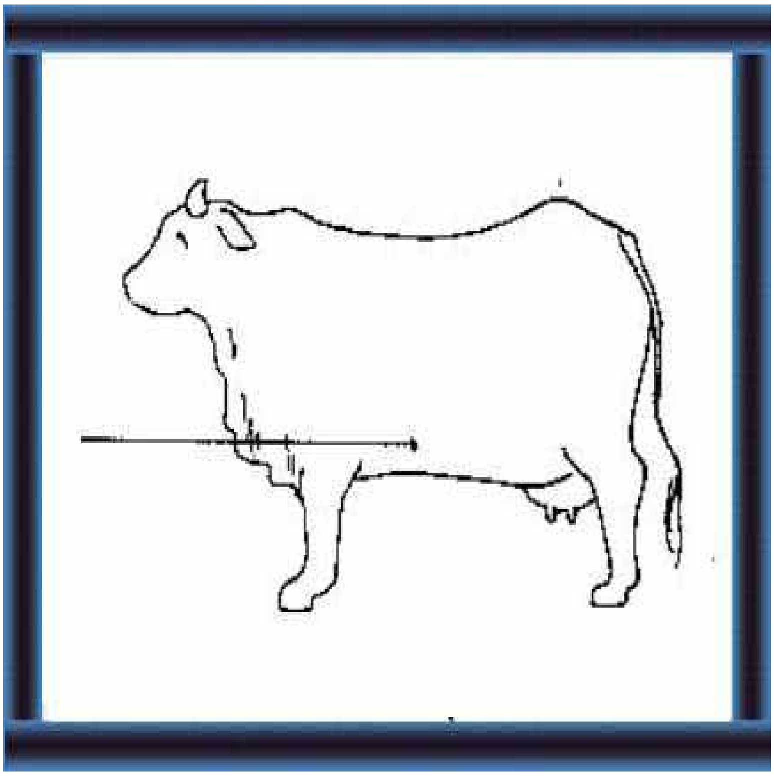


Digestible crude protein (DCP)

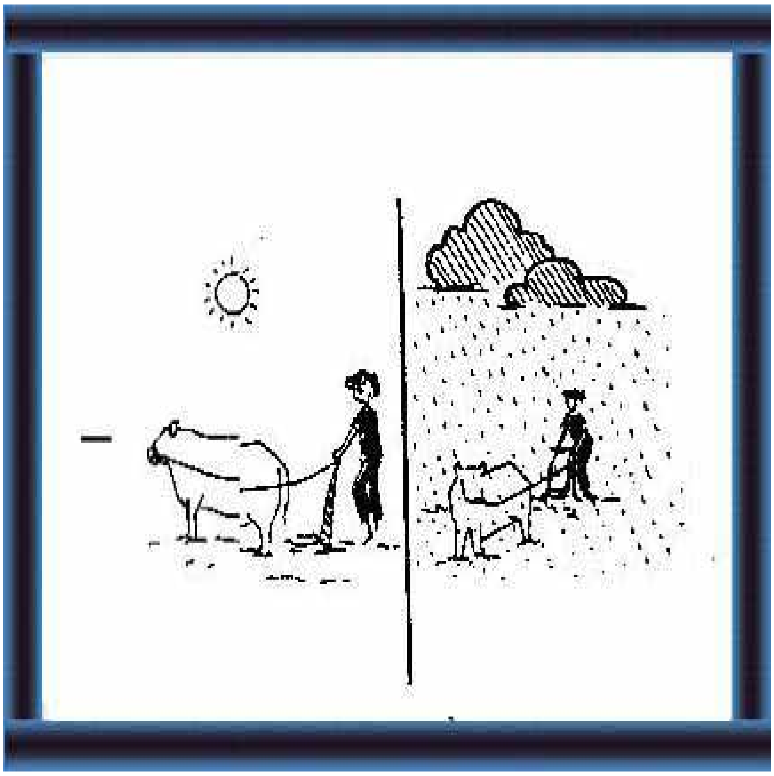
47 DCP tells you **how much protein** your animals can get from feed.



48 If your feed has **20 % DCP** your animals can get **200 g** of **protein from 1 kg of feed**.

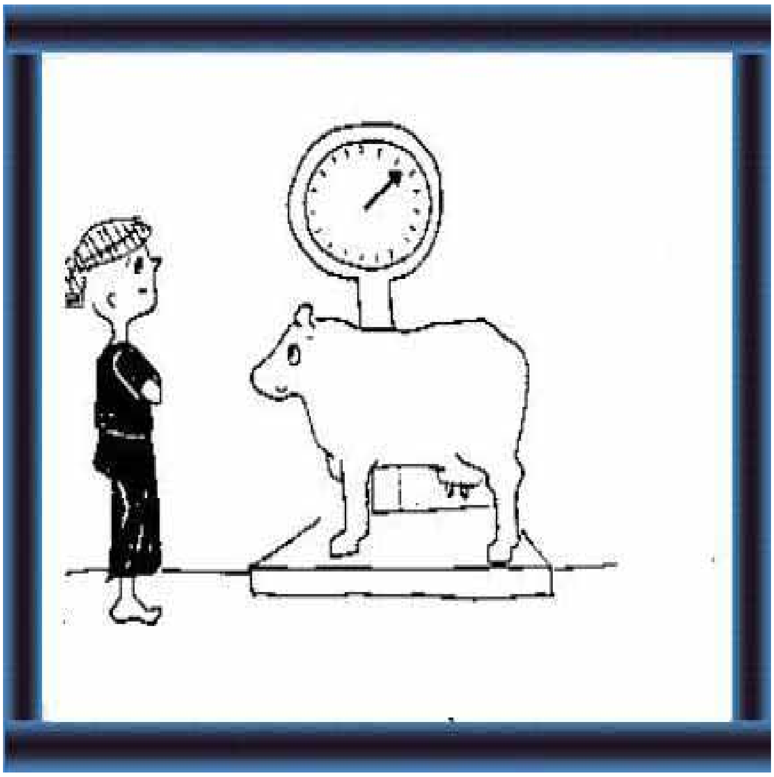


Minerals
49 Important minerals are necessary.
If your feed has **1 % phosphorous** your animals can digest **10 g of phosphorous** in **1 kg of feed**.



Dry matter content (DM)
50 The DM of feeds is very different in:
- different types of feed
- stage of harvesting or growth
- type of processing
- climate.

51 **Check carefully** if the TDN, DCP and mineral values are percentages of the **DM or** the **total feed**. Consult your extension worker .



How can you find the feed intake of your animals?

52 **Feed intake (DM of feed)**

A simple way is to take:

$$\frac{\text{body weight} \times 3}{100}$$

Feed intake (52-61)

A feed has two main components: water and dry matter. It is the DM component that supplies the nutrients. Therefore, feed intake refers to dry matter intake (DMI).

The approximate DMI of cattle can be computed in different ways:

- 3 % of the body weight
- 21/2 % of body weight + 10% of milk yield
- 6 kg + 1 % of body weight + 20 % of milk yield

The estimated DMI based on the last method of computation is given in Table 1 in Annex 2.

The DMI depends on many factors. Among them are availability of water, type and quality of roughage, feeding frequency, amount of concentrates given, digestibility of the feeds, condition of the animal, weather conditions etc.

Roughages are very important in the diet of ruminants because they supply the crude fibre which is necessary for proper functioning of the rumen. Optimally 18-20 % of the DMI has to be crude fibre.

If the crude fibre content is too low, milk fat content in the milk can fall. On the other hand, if the crude fibre content is too high, the animal will not be able to consume sufficient DM. Thus it will not receive all its requirements of energy and proteins, and the milk yield will drop.

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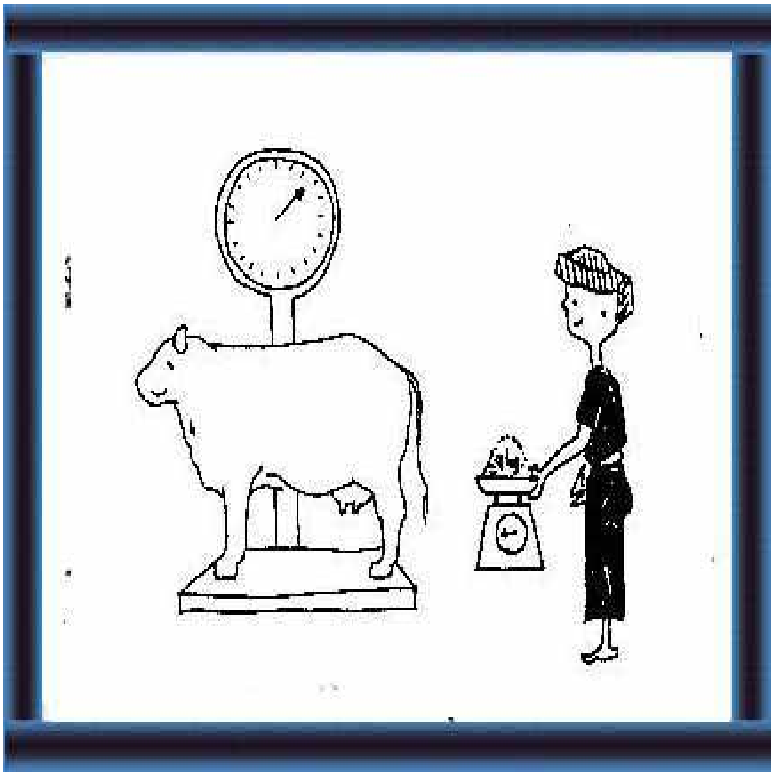
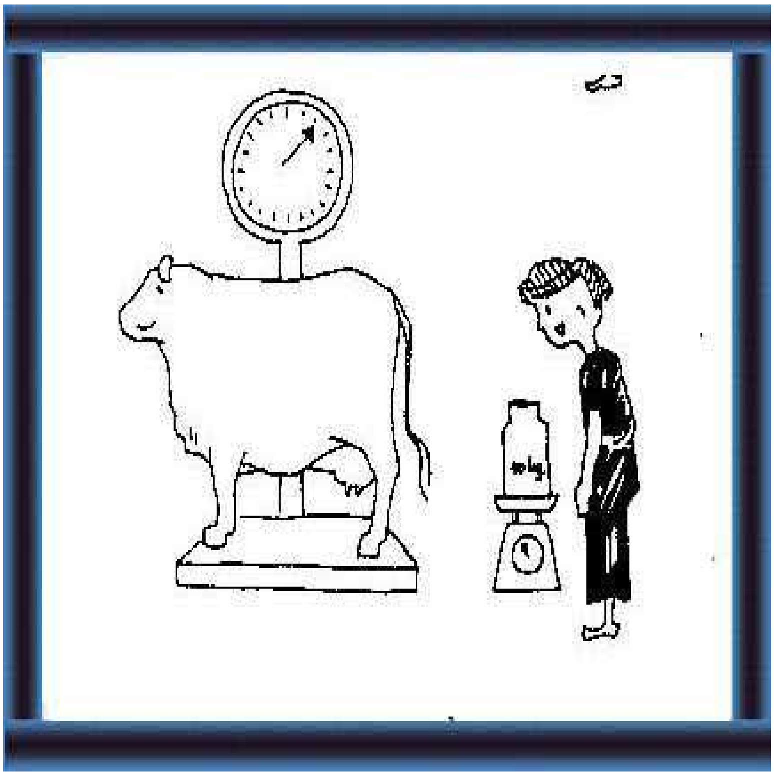
53 So for a 300 kg cow, the



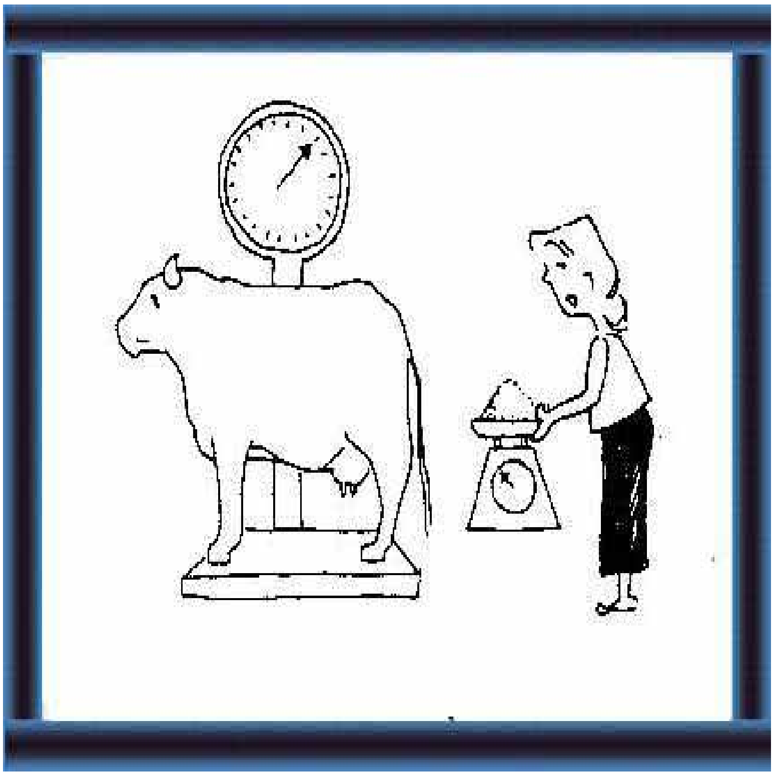
feed intake is:

$$\frac{300\text{ kg}}{100} \times 3 = 9\text{ kg}$$



54 To allow for **milk yield**, you can estimate the feed intake as:

$$6\text{ kg} + \frac{\text{body weight}}{100} + \frac{\text{milk yield}}{5}$$

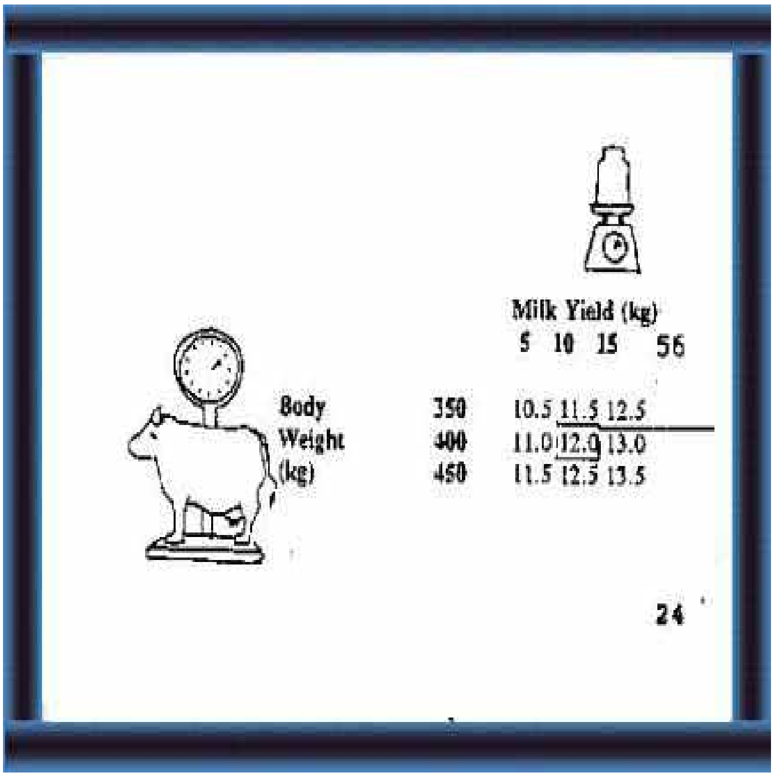


55 So, for

300 kg cow 10 kg milk yield,

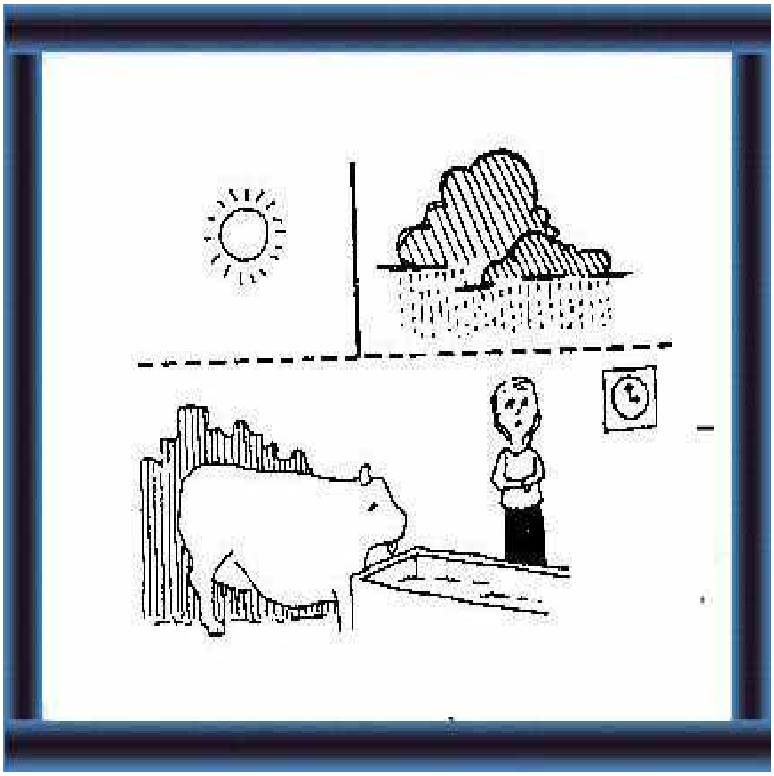
feed intake is:

$$6\ \text{kg} + \frac{300\ \text{kg}}{100} + \frac{10\ \text{kg}}{5} = 11.0\ \text{kg}$$



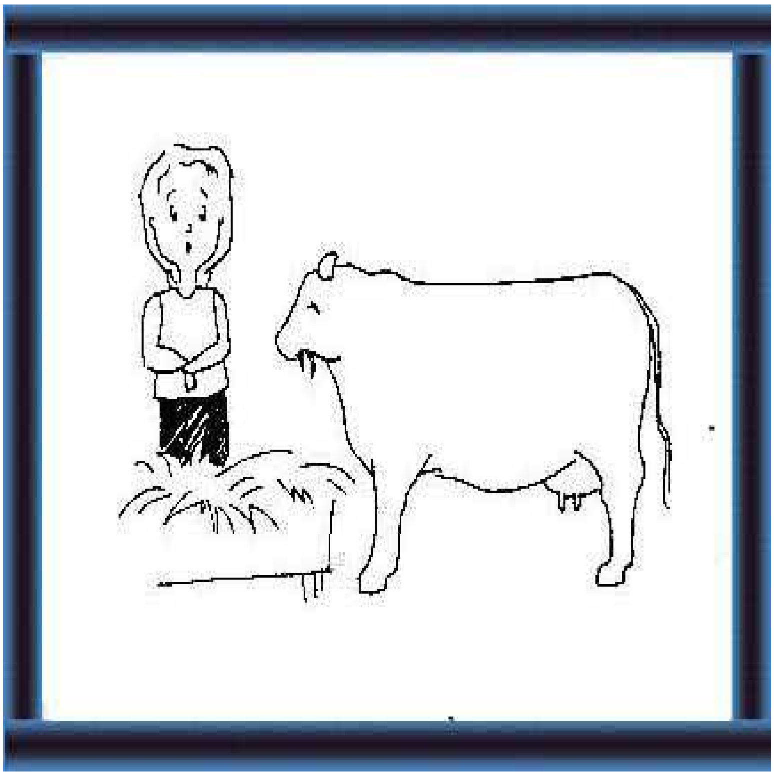
56 Ask your extension worker to show you a table.

Feed intake for a 400 kg cow with a milk yield of 10 kg.

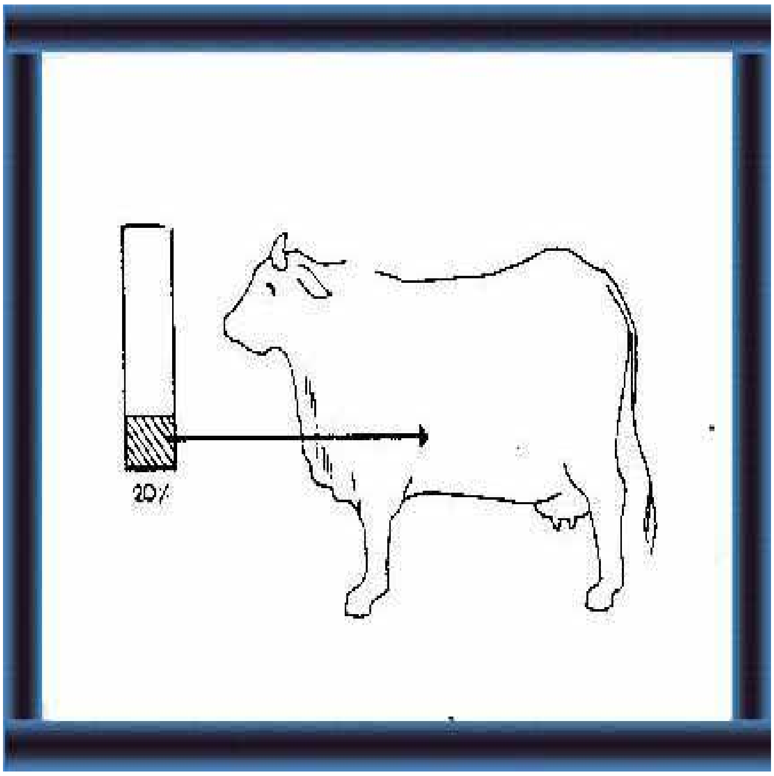


57 The feed intake depends on:

- climate
- availability of water
- how often you feed your animals

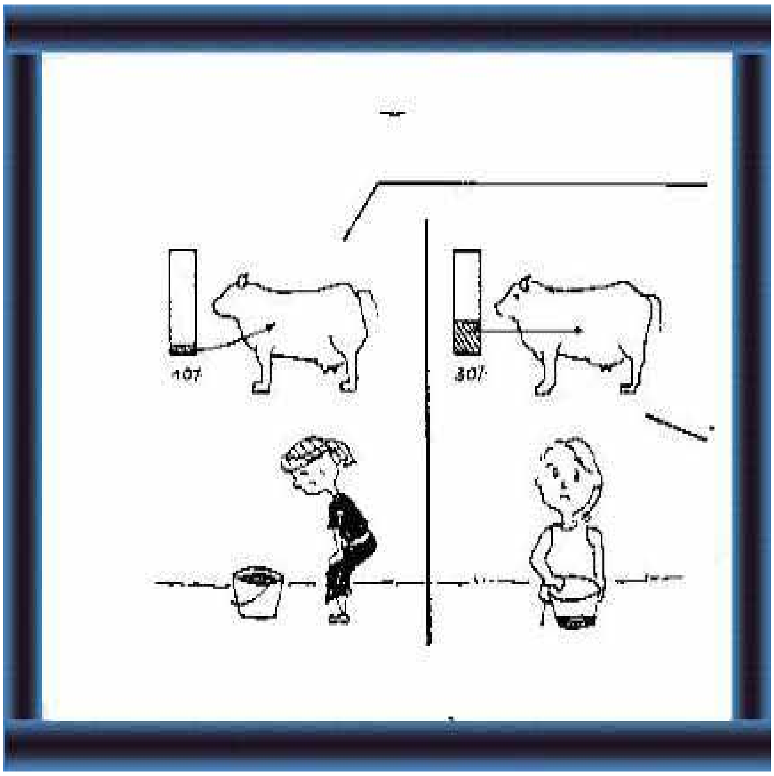


58
- the type and quality of roughages
- the amount of concentrates
- how digestible the feeds are etc.



59 At least **20 %** of the feed intake should be **crude fibre** for good digestion.

Roughages are important because they **provide crude fibre**.



60 **Too little crude fibre** content leads to **low milk fat content**.

Too high crude fibre content leads to **poor feed intake** and **low milk yields**.

Water intake (62-64)

Water is an essential requirement for the proper functioning of animals. Some of its main actions relate to: digestion and absorption of food; transport of nutrients throughout the body and metabolic wastes to the excretory organs (being a component of all body fluids); control of body temperature (conductive and evaporative cooling) and milk secretion (being a component of the milk).

Animals obtain their water requirements from three main sources:

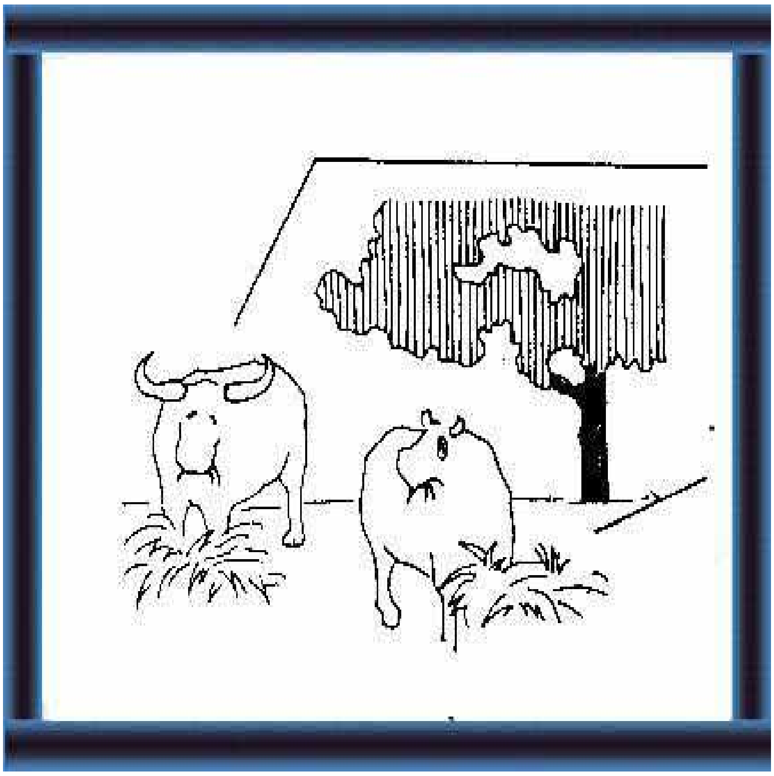
- water in the food;

- water consumed voluntarily;

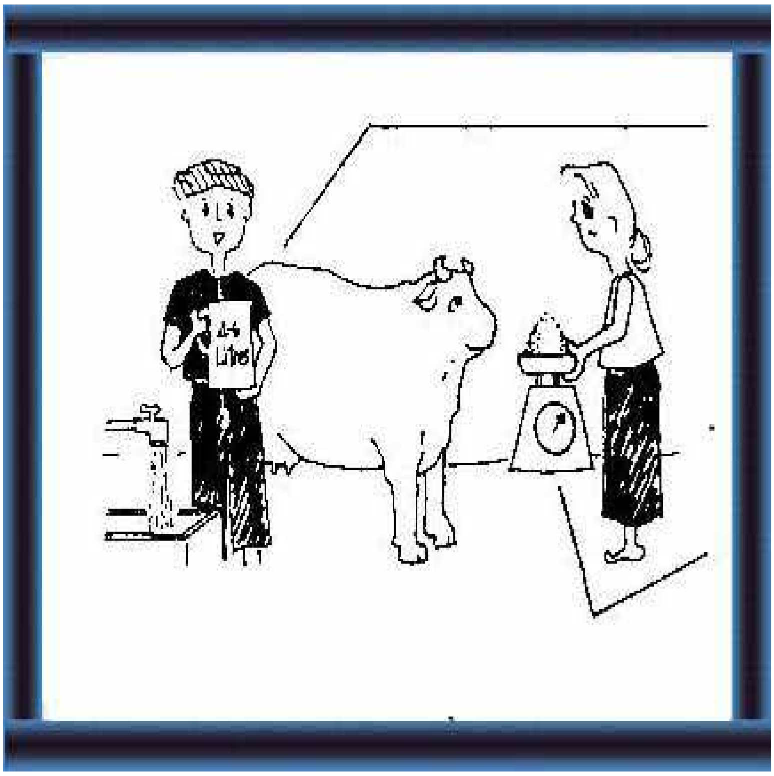
- water formed in metabolic activities of the body.

As a rule of thumb, lactating cows require 4 to 6 litres of water per kg DM consumed. Higher amounts may be required in hot tropical conditions.

The ideal is to allow dairy cattle and buffalo continuous access to drinking water. Where this is not possible, they should be offered as much as they can drink, at least twice a day.

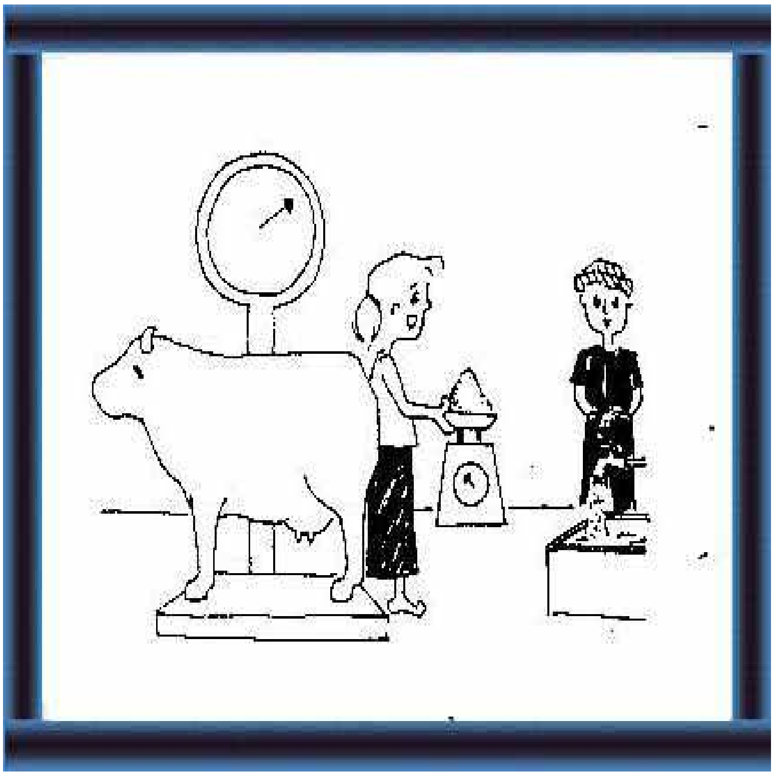


61 Buffaloes can make use of coarse feeds better than cattle.



Water intake

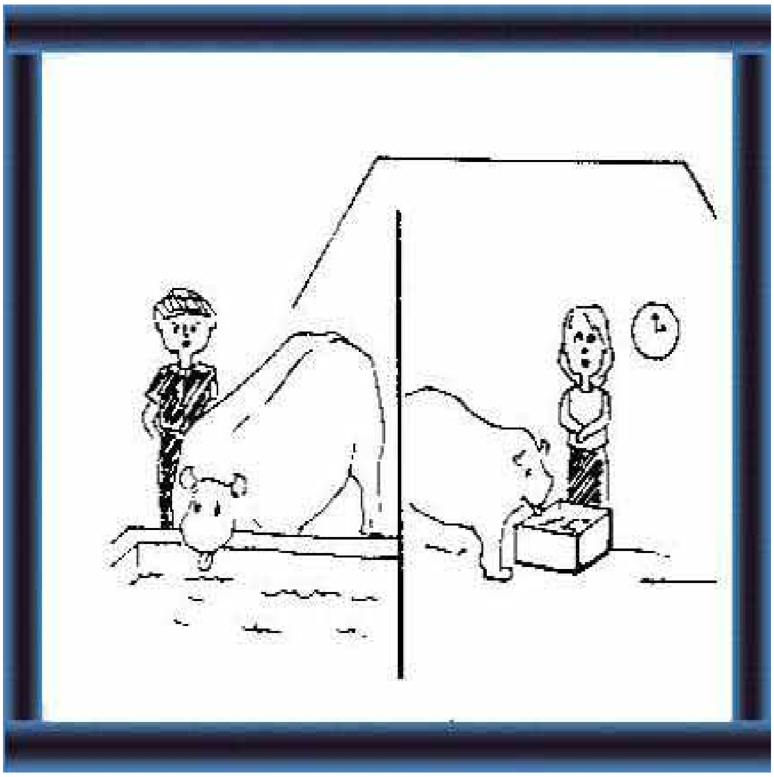
62 You can estimate that **lactating cows** need **4-6 l of water** for **each 1 kg of feed intake** (DM).



63 So the 300 kg cow with a 10 kg milk yield and 10 kg feed intake needs:

11 kg x 6 l = 66 l

(feed intake) (water)



64 If possible, give your animals **free access** to water.

If not, make sure they have **enough** to drink **at least** twice a day.

Nutrient requirements (65-73)

The requirements of the different nutrients vary depending on several factors. Basically they can be considered as maintenance requirements and production requirements. Compare the nutrient requirements of dairy cattle/buffalo to the fuel requirements of a motorcycle.

Maintenance requirement is the requirement of nutrients to just maintain the animal without losing body weight. It depends on the size of the animal, which is usually measured in terms of its weight.

(If a motorcycle is started without being put to any use, some fuel and lubricating oils will be used up. In a similar manner, the living animal also uses up mainly energy and proteins and also small quantities of other nutrients, just to maintain the body mechanisms functioning.)

Production requirement is the requirement of nutrients for the various production functions. The different production functions require varying amounts of nutrients.

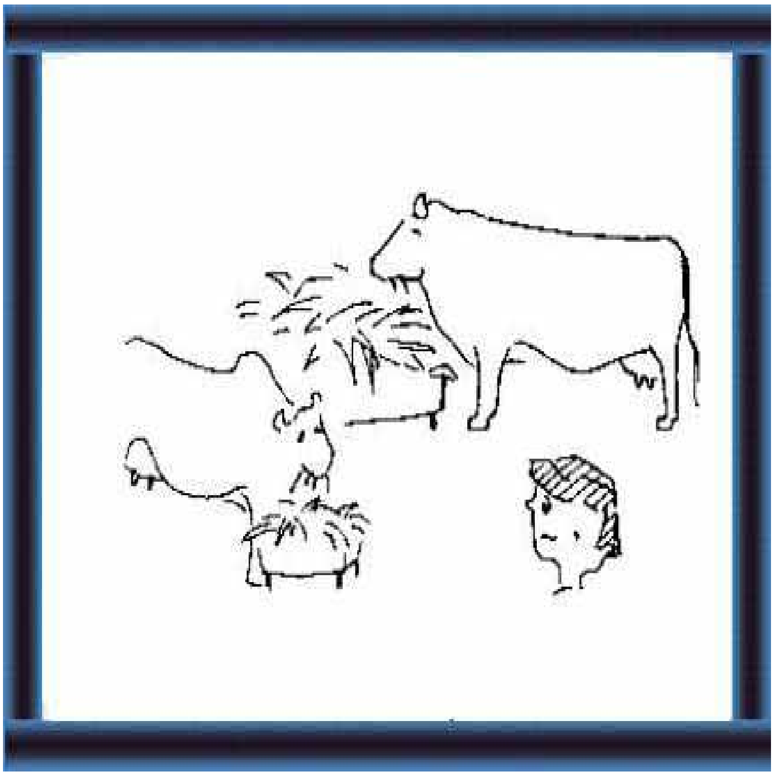
- A young animal that is still growing requires more nutrients in addition to its requirement for maintenance.

(A motorcycle requires more fuel and oil to be driven from one place to another.)

- A pregnant animal requires more nutrients for the growth of its calf (foetus) in addition to its own maintenance re-quirement. A young growing heifer which is also pregnant requires nutrients for maintenance, its own growth and the growth of its calf.

(Compare to a motorcycle - using its engine power to move from one place to another, with an additional passenger.)

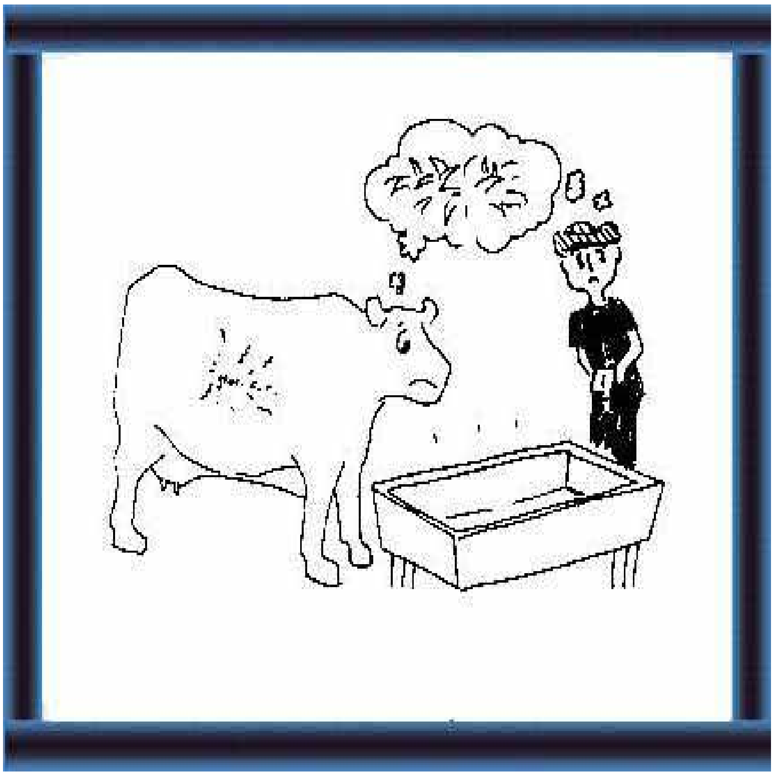
How can you find the nutrient requirements of your animals?



Maintenance requirement

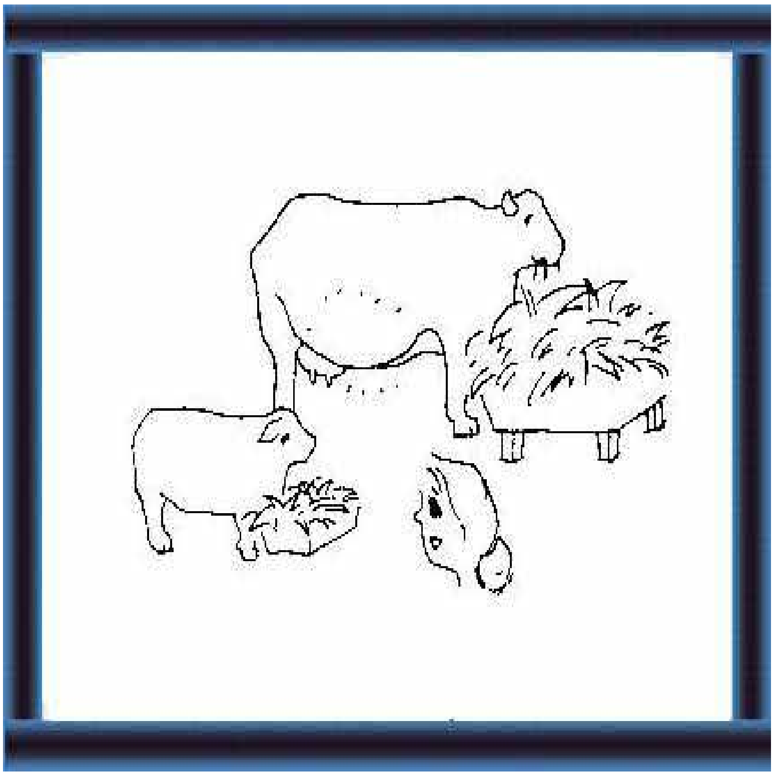
65 This is the amount of nutrients an animal **needs** when it is **not** growing or producing.

It depends on the **weight**.

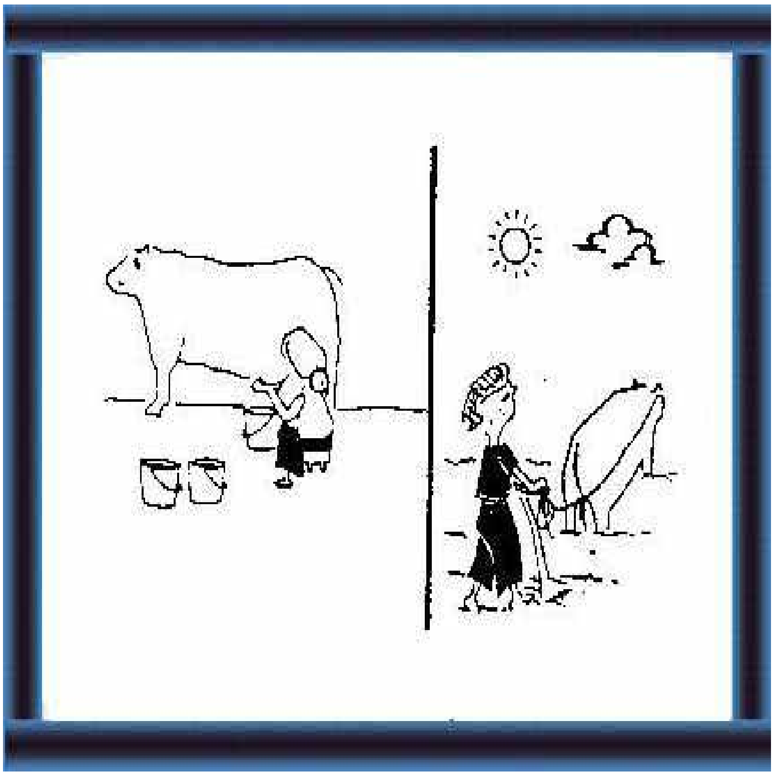


Production requirement

66 Your animal needs **more** than the maintenance requirement to **produce** = production requirement



67 Your animal needs **extra nutrients** for:
- growth
- pregnancy



68
- milk production
- work.

- A lactating animal requires more nutrients for milk production in addition to its maintenance requirement. Thus a cow that starts lactating before completing its own growth requires nutrients for its maintenance, own growth and milk production.

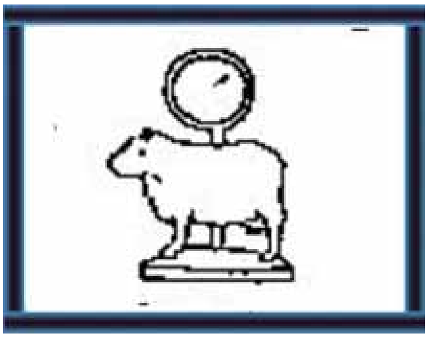
(Compare to a motorcycle - using its engine power moving from one place to another, up a hill.)

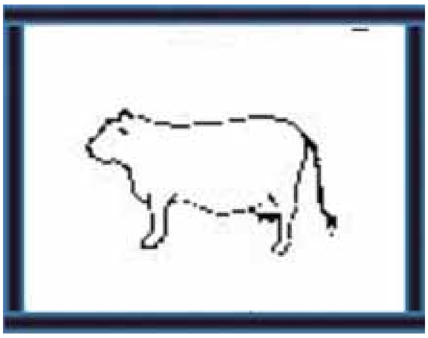
- An animal that is used for work requires more nutrients for work in addition to its maintenance requirement.

(Compare to a motorcycle used to pull a carriage.)

The nutrient requirements of dairy cattle have been worked out under experimental conditions. (See Tables 2 and 3 in Annex 2)

Ask your extension worker to show you tables:

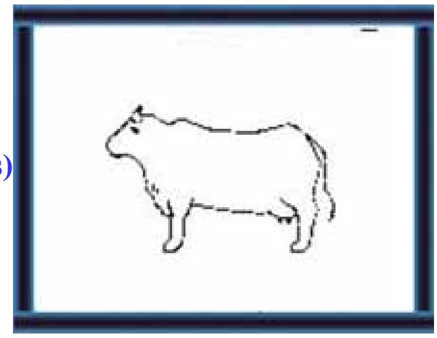




69 **Growing heifers (small breeds)**

Body weight (kg)	Daily weight gain (kg)	Protein Total (g)	DCP (g)	Energy TDN (kg)	Minerals Calcium	Phosphorus
50	500	215	160	0.9	4.9	3.8
75	550	275	190	1.2	7.0	5.4
100	550	320	210	1.6	9.0	7.0

70 **Growing heifers (large breeds)**



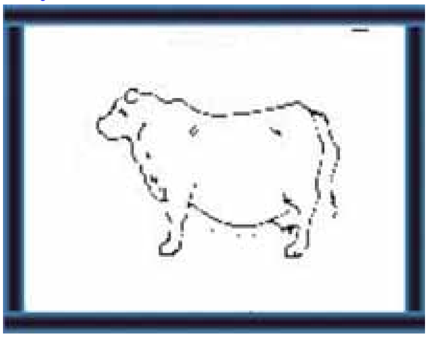
Body weight (kg)	Daily weight gain (kg)	Protein Total (g)	DCP (g)	Energy TDN (kg)	Minerals Calcium	Phosphorus
100	750	370	260	2.0	10.9	8.4
150	750	435	295	2.7	15.0	12.0
200	750	500	330	3.4	18.0	14.0

71 **Maintenance of mature lactating cows**

350	**468**	**220**	**2.8**	**14.0**	**11.0**
400	**521**	**245**	**3.1**	**17.0**	**13.0**
450	**585**	**275**	**3.4**	**18.0**	**14.0**

72 **Maintenance and pregnancy**

(last 2 months of gestation)



500	**780**	**430**	**4.8**	**29.0**	**22.0**
550	**850**	**465**	**5.2**	**31.0**	**24.0**
600	**910**	**500**	**5.6**	**34.0**	**26.0**

73 **Milk production (nutrients/kg milk)**

% Fat

4.0	**78**	**51**	**0.330**	**2.7**	**2.0**
4.5	**82**	**54**	**0.355**	**2.8**	**2.1**
5.0	**86**	**56**	**0.380**	**2.9**	**2.2**

Balanced rations (74)

Remember that all nutrients have to be supplied in required amounts. If there is a deficiency in the supply of any one nutrient, the animal will be unable to utilize adequately the other nutrients supplied.

The principal of the minimum bucket applies. The deficient nutrient limits the utilization of the others.

Therefore, balanced rations should be supplied in adequate amounts.

The extension officer should:

- develop the skills to formulate suitable rations incorporating available feeds for the dairy cattle/buffalo in the local area, using the standard nutrient requirements and nutritive values of various feeds as guidelines; and

- advise farmers on feeding these rations to their cattle and buffalo.

Ration calculation (75-83)

An example is worked out below to show how to do a ration calculation. The example is simplified for easy understanding of the principles. The field situation can be more difficult and variable.

To get a clearer picture of the field situation, a ration calcu-lation worksheet can be used. (See extension materials).

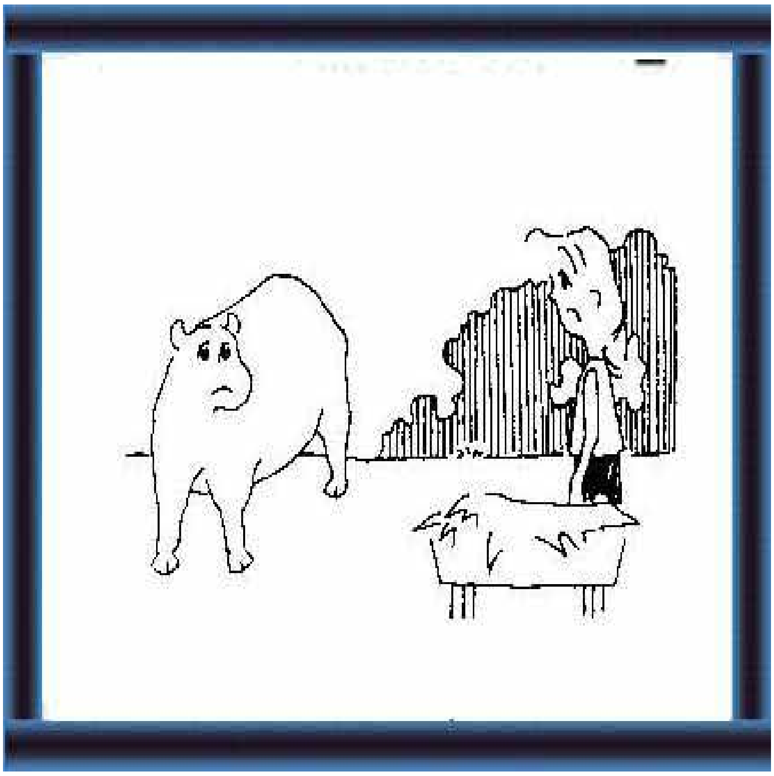
Step 1 - Obtain general data

- age and body weight of cow
- milk yield and fat percentage
- stage of lactation and pregnancy and lactation number
- feeds available and their nutritive values
- tables of nutrient requirements

Assume step 1 results in the following information:

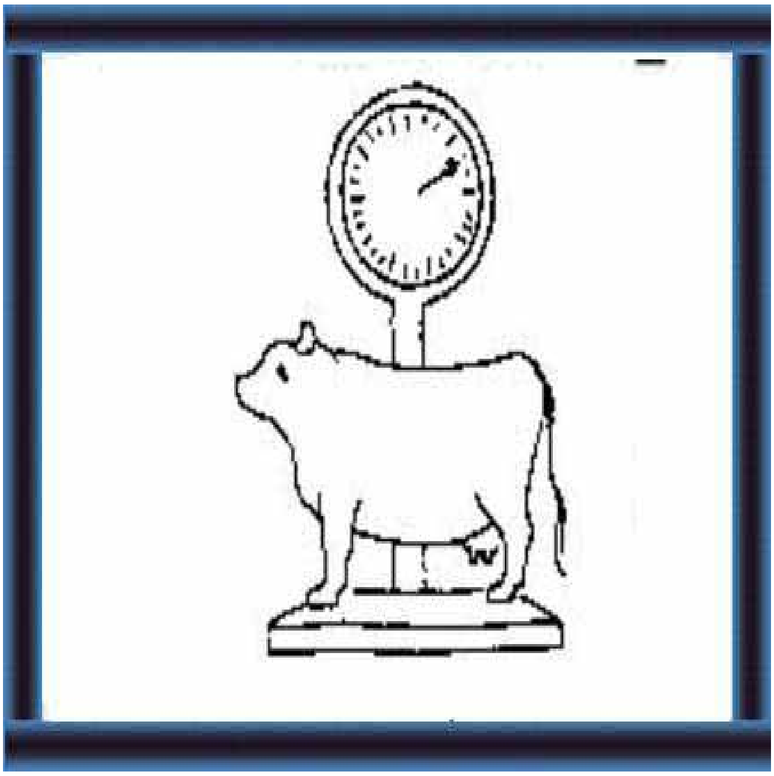
Crossbred cow; age 4 years and body weight 400 kg; daily milk yield 10 kg with 5 % butter fat; 2nd month of lactation; not pregnant and lactation number 2:

Feed available	Nutritive value		
	DM (%)	TDN (% DM)	DCP (% DM)
Fresh grass	20	60	4
Concentrate mix	90	70	18



Balanced rations
74 Your animals need **balanced rations**.

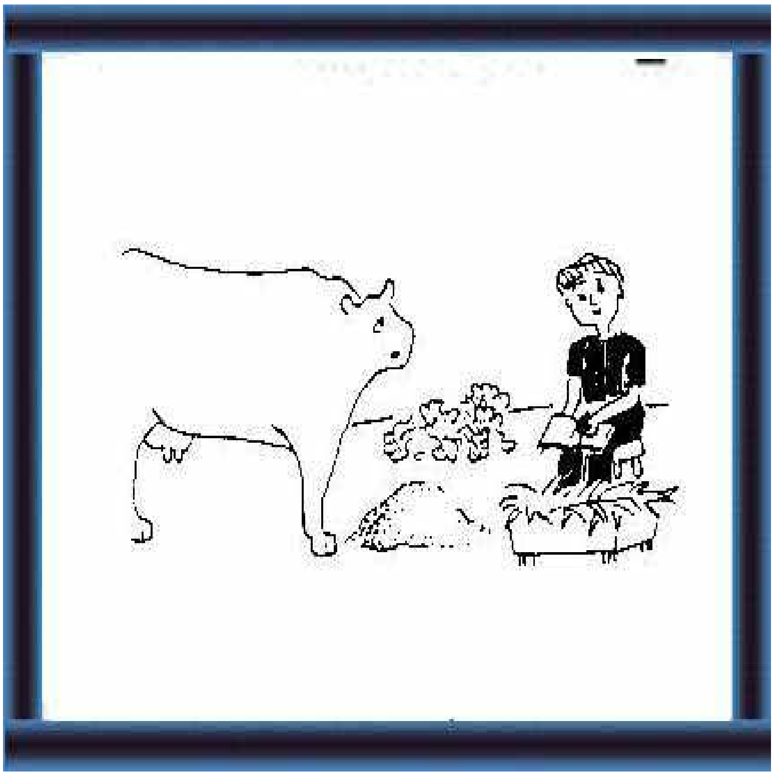
If **one nutrient** is **lacking**, they **cannot** make good use of the **other nutrients**, even if the other nutrients are sufficient.



How can you calculate rations?
75
A: INFORMATION REQUIRED
You must collect **information** for your worksheet (See **A** on next page) e.g.:

Your crossbred cow
Age: 4 years
Body weight: 400 kg
Pregnant: No
Lactation: 2nd month of 2nd lactation.

76 **Your milk**
Milk yield: 10 kg/day
Butter fat: 5 %



77 Your Feeds

Availability
Nutritive value

	DM (%)	**TDN (% DM)**	**DCP (% DM)**
Fresh grass	**20**	**60**	**4**
Concentrate mix	**90**	**70**	**18**

RATION CALCULATION WORKSHEET

Farmers name: Date: **Advisors name: Cow No:**	
INFORMATION REQUIRED **Weight of cow: (kg) Milk yield: kg/ day** **Stage of lactation: (months) Butterfat %** **Age of cow: (years)** **Dry matter intake: kg Gestation: months** **Feeds available: Lactation No:** **a) on the farm:** **b) purchasable:**	**A**
ANIMAL REQUIREMENTS **TDN kg Protein kg** **Maintenance:** **Desired weight gain:** **Milk production:** **Gestation:** **TOTAL:**	**B**
NUTRIENT CONTENT OF FEEDS AVAILABLE **Feed DM % TDN % Protein % Cost per kg** **1** **2** **3** **4** **5** **6** **7** **8** **9** **10**	**C**
FINAL RATION RECOMMENDED **Forage:** **Concentrate:**	D

<u>Notes:</u> 1 Desired weight gain: add 20 % to the maintenance allowance during the first lactation and 10 %

during the second lactation.

2 At least 25% of DMI must come from forage to protect milk quality.

Step 2 - Fill in part A of ration calculation sheet

Step 3 - Calculate the requirements of the cow (part B of sheet) as follows:

Animal's requirements	**DM (kg)**	**TDN (kg)**	**DCP (kg)**
Maintenance	**-**	**3,1001**	**2451**
Desired weight gain	**-**	**3102**	**252**
Milk production	**-**	**3,8003**	**5603**
Gestation	**-**	**-**	**-**
Total	**12.04**	**7,210**	**830**

(1) The relevant values for cow of 400 kg body weight from Table 3.

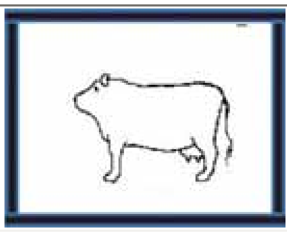
(2) 10 % of maintenance requirement as the cow is in second lactation.

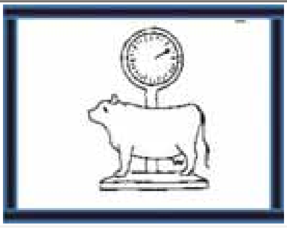
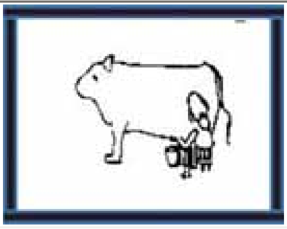
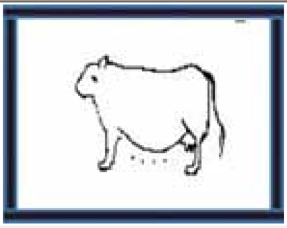
(3) The relevant values against 5 % fat in Table 3 multiplied by 10.

(4) Given value for 400 kg cow with 10 kg milk yield per day. See # 56

B: ANIMAL REQUIREMENTS

78 You must calculate the requirements of your cow:

	Animal Requirements	**DM (kg)**	**TDN (g)**	**DCP (g)**
	Maintenance[1]		3,100	245

	Desired weight gain[2]		310	25
	Milk production[3]		3,800	560
	Gestation		-	-
	Total	**12.0[4]**	**7,210**	**830**

Note:
1 See the table in 71 above for a 400 kg cow.
2 As the cow is in 2nd lactation, take 10 % of the maintenance ration:

$$\text{TDN} = \frac{3,100\text{ g}}{10} = 310$$

$$\text{DCP} = \frac{245\text{ g}}{10} = 25\text{ g}$$

3 See the table in 73 above for 5 % fat. For 10 kg milk/day:

TDN = 0.380 kg x 1,000 g x 10 = 3,800 g

DCP = 56 g x 10 = 560 g

4 See the table in 56 above - DM for a 400 kg cow with a milk yield of 10 kg/day.

Step 4 - Calculate the amount of nutrients that can be supplied by roughages

In this example, only one roughage is considered. In the field various combinations of roughages may have to be considered. In any event, the availabilities of roughages will vary during different seasons. Therefore, fresh computations have to be done when the availability changes.

If the total DM requirement of 12 kg is supplied with the available fresh grass, the nutrients supplied are:

TDN (600 x 12)	**= 7,200 g**
DCP (40 x 12)	**= 480 g**

Therefore, there is a shortfall of (7,210 - 7,200 =) 10 TDN and (830 - 480 =) 350 g DCP.

It is also unlikely that the cow will consume (100/20 x 12 =) 60 kg of the fresh grass to obtain 12 kg of DM from grass alone, because of the bulk and the low palatability.

Therefore, it would be necessary to offer a concentrate to meet the shortfall.

Step 5 - Calculate the amount of nutrients that have to be supplied from concentrates

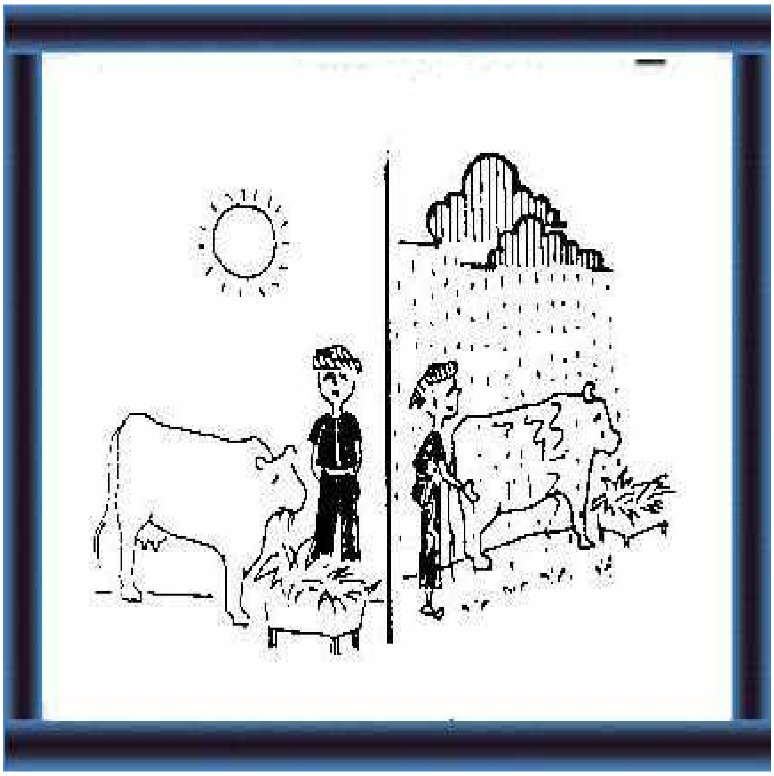
In this particular example, it is assumed that the cow will consume only about 9 kg DM of grass i.e. (100/20 x 9 =) 45 kg of fresh grass.

	DM (kg)	TDN (kg)	DCP (kg)
Total requirement	12	7,210	830
Supplied from grass	9	5,400	360
Shortfall	3	1,810	470

By supplying 3 kg DM of the concentrate containing 70 % TDN and 18 % DCP, 2,100 g TDN and 540 g DCP will be available to the cow, thereby meeting the shortfall in the nutrients. If the concentrate mixture contained 90 % DM, the amount of concentrate mixture to be supplied is (100/90 x 3 =) 3.3 kg.

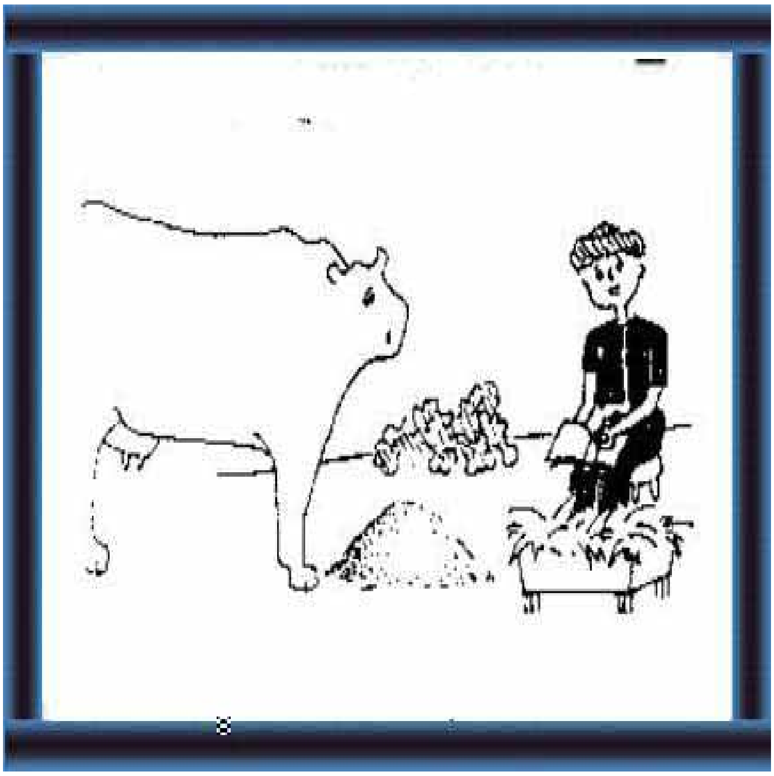
C: NUTRIENT CONTENT OF FEEDS AVAILABLE

You must calculate the amount of nutrient available from:



Roughages
79 **Different roughages** are available in **different areas** and **different seasons**.

Calculate **again** where the roughage changes. Here is an example for **one** roughage: fresh grass.



80 Your cow **needs** (See 70-72):

DM
TDN **DCP**

Requirements
12.0 kg 7,210 g 830g

If your fresh grass provides (See 77):

DM	TDM	DCP
20 %	60 %	4 %

20 kg DM come from 100 kg fresh grass so 12 kg DM come from $^{100}/_{20}$ x 12 kg = 60 kg fresh grass	1 kg DM provides 600 g TDN so 12 kg DM provide 600 x 12 = 7,200 g TDN	1 kg DM provides 40 g DCP so 12 kg DM provide 40 x 12 = 480 g DCP
	7,200 g TDN & 480 g DCP are available in 60 kg fresh grass	

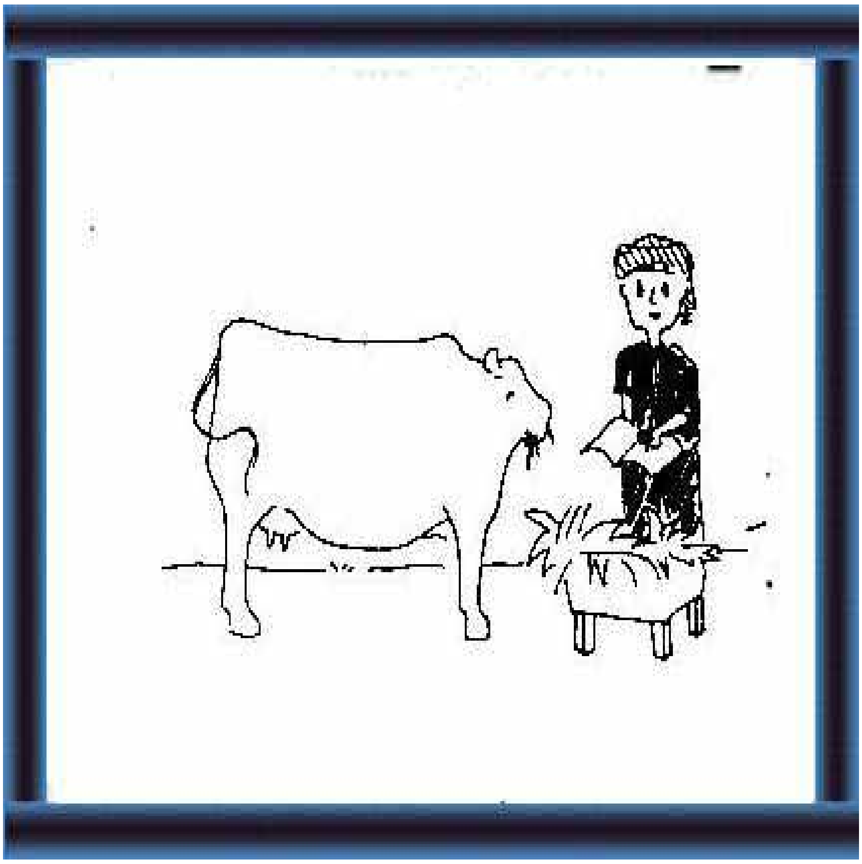
NUTRIENT REQUIREMENTS - NUTRIENTS AVAILABLE = SHORTFALL

TDN: 7,210 g - 7,200 g = 10 g TDN

DCP: 830 g - 480 g = 350 g DCP

You must offer your animals concentrates to make up for this shortfall.

Concentrates

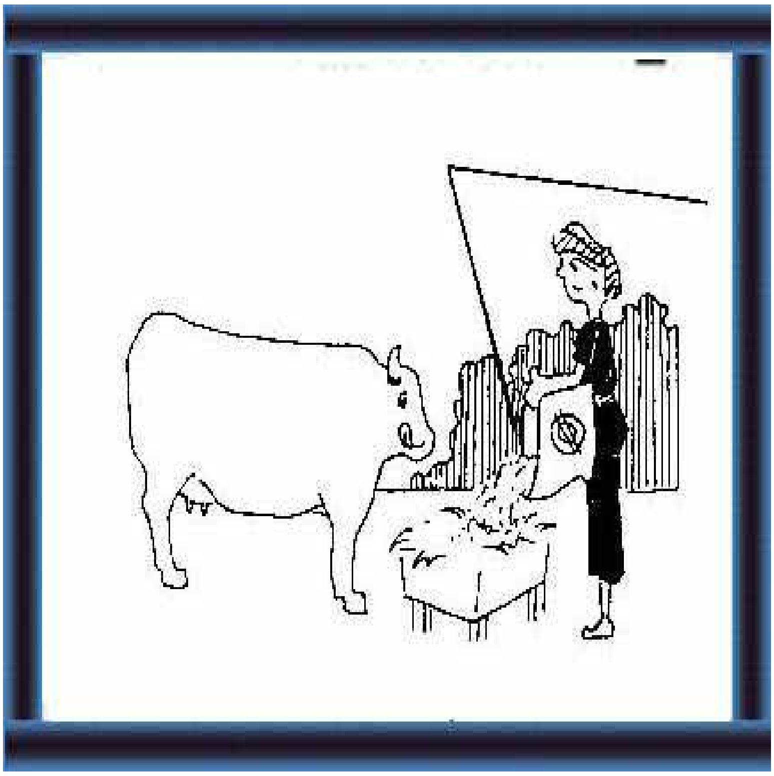


81 If your cow **only consumes 45 kg fresh grass** (9 kg DM)

	DM (kg)	TDN (g)	DCP (g)
Your cow's requirement	12	7,210	830
Available in	9 kg	5,400	360
Fresh grass short fall	3	1,810	470

82 If you use this concentrate:

DM (kg) **TDN**



(70%) **DCP (18%)**

1 kg 700
g 180 g

3 kg 2,100
g 540 g

3 kg DM is enough to meet the shortfall.

83 If the concentrate is **90 % DM**, you need

3 kg x 100 = **3.3 kg concentrate**
90
to **meet the shortfall**.

If your cow eats **less than 45 kg fresh grass**, then you need **more concentrates**.

Concentrate mixtures (84-87)

Sometimes it is necessary to make concentrate mixture to meet particular needs.

If:

(i) - in the above example (Step 5), the shortfall from the fresh grass was 1,800 g TDN and 400 g DCP i.e. the grass contained more DCP;

(ii) - in the concentrate mixture that was available (i.e. concentrate mixture 1) each kg DM contained 700 g TDN and 180 g DCP i.e. 180 g DCP per 700 g TDN or (180/170 x 1,000 =) 257 g DCP per kg TDN;

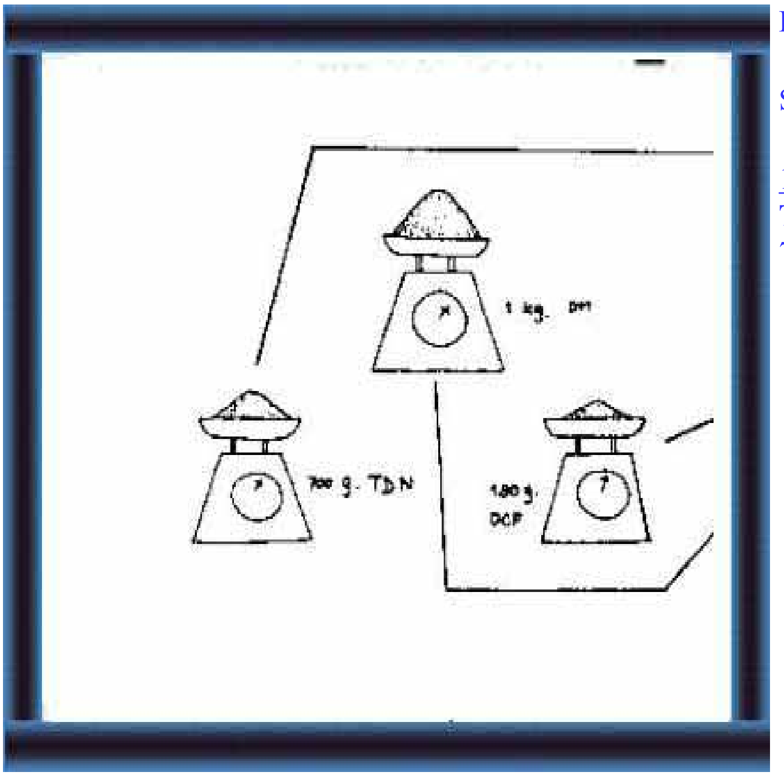
(iii) - the requirement would be 1,800 g TDN and 400 g DCP i.e. (400/1,800 x 1,000 =) 222 g DCP per kg TDN.

The requirement, therefore, is for a mixture with less DCP than the one available. If the available mixture is fed, there will be a wastage of DCP, when adequate TDN is supplied.

This mixture has to be balanced with another feedstuff with less DCP. Suppose rice bran with DM 90 %, TDN 50 % and DCP 9.0 % is available. It has 90 g DCP per 500 g TDN or (90/500 x 1,000 =) 180 g DCP per kg TDN.

Concentrate mixes

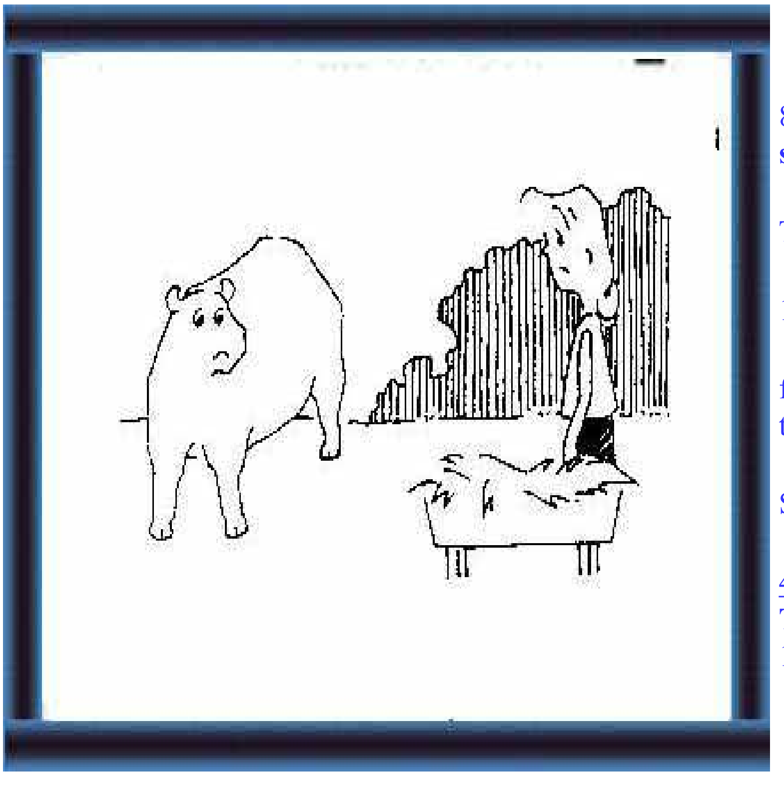
84 The concentrate in 82 above provides 700 g TDN and 180 g DCP for **each** 1 kg



DM.

So **1 kg TDN provides**

$\frac{180}{700} \times 1{,}000 =$ **257 g DCP/kg TDN**



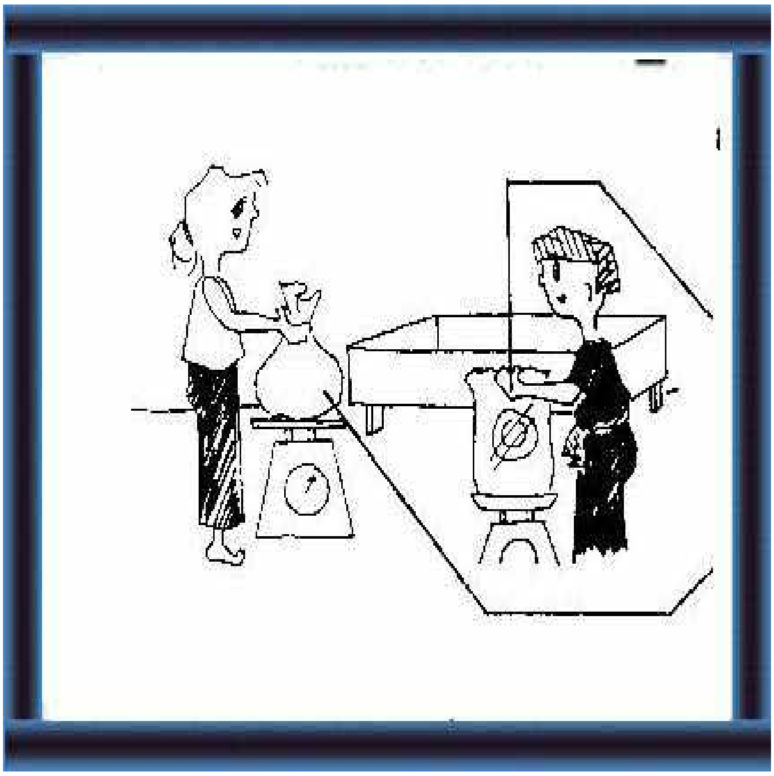
85 This farmer has a **shortfall** of:

TDN	DCP
1,800 g	400 g

from the roughage available to him.

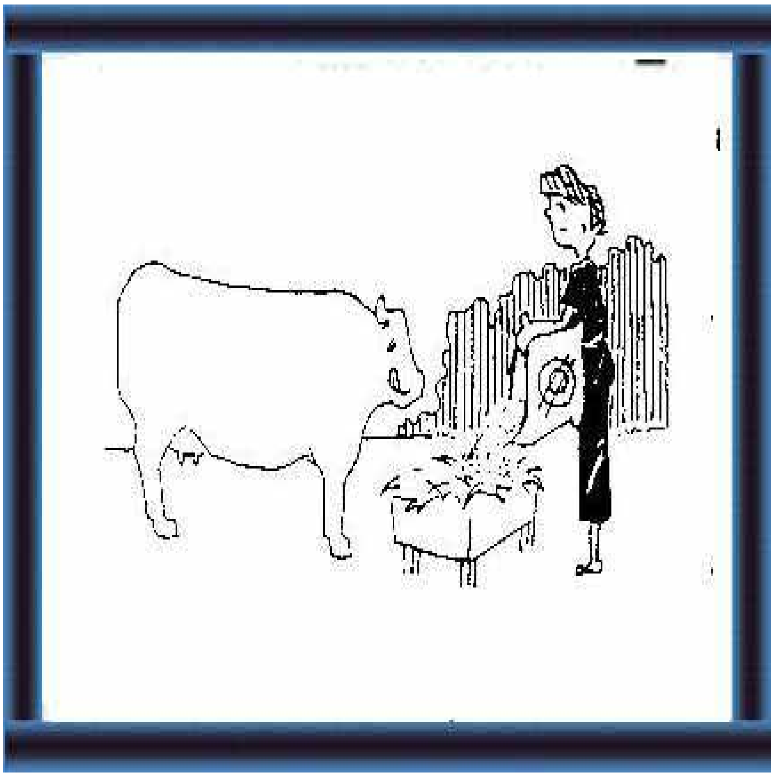
So the **requirement** is:

$\frac{400}{1{,}800} \times 1{,}000 =$ **222 g DCP/kg TDN**



86 If he feeds the concentrate in 82, when the animal has **enough TDN**, there is a **wastage of DCP**.

He can **mix** the concentrate with a feed which has **less DCP** e.g. rice bran with the following composition:



87

DM	TDN	DCP
90 %	50 %	9 %

So the rice bran has:

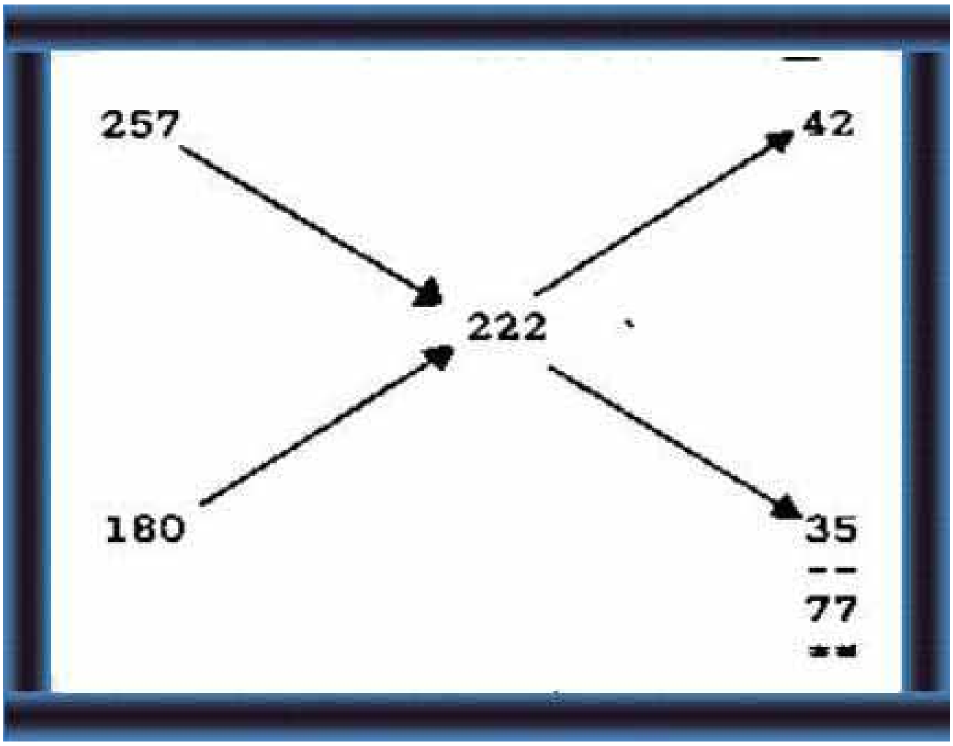
90 g DCP/500 g TDN or

$\frac{90}{500} \times 1{,}000 =$ **180 g DCP/kg TDN**

By using Pearson's Square, the composition of the new ration (i.e. concentrate mixture II) can be calculated.

Concentrate MixtureI

Concentrate Mixture II



Rice bran

The new concentrate mixture (i.e. concentrate mixture II) should contain (35/77 x 100) = 45 % DM for rice bran and (42/77 x 100) = 55 % DM from concentrate mixture I. As the DM contents of the concentrate mixture I and rice bran are given as 90 % the quantities to be used by weight are also in the same proportions. If the DM contents are different, the proportions of concentrates mixture I and rice bran have to be adjusted accordingly.

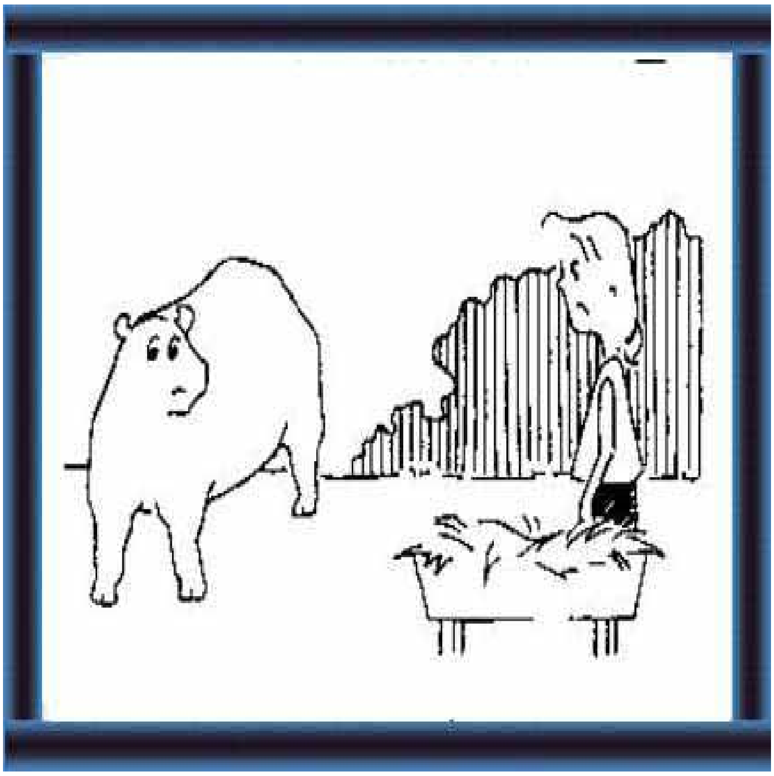
3 kg DM of concentrate mixture II would contain 1,650 g DM from concentrate mixture I and 1,350 g of DM from rice bran. The nutrients supplied by 3 kg DM of the concentrate mixture II are as follows:

Feed	Quantity of DM (g)	TDN (g)	DCP (g)
Concentrate 297 Mixture I	**1,650**	**700 x 1,650 = 1,155 1,000**	**180 x 1,650 = 1,000**
Rice bran	**1,350**	**500 x 1,350 = 675 1,000**	**90 x 1,350 =121 1,000**
Concentrate Mixture II	**3,000**	**1,830**	**418**

This shows that 3 kg DM which is equal to (100/90 x 3 kg =) 3.3 kg by weight of concentrate mixture II are adequate to meet the shortfall of TDN and DCP supply from fresh grass.

He can use **Pearson's Square** to calculate the composition of the new concentrate mix.

			Concentrate Mix
Concentrates (from 82)	**257 g DCP/ kg TDN available**		**42 (222-180) parts concentrate (from 81)**
		222 g DCP/kg TDN requirement	
Rice bran	**180 g DCP/ kg TDN available**		**35 (257-222) parts rice bran**
			77 (42+35) parts concentrate mix



So for a concentrate mix with 222 g DCP/kg TDN, mix:

$\frac{35}{77} \times 100 = 45\%$ DM rice bran with

$\frac{42}{77} \times 100 = 55\%$ DM concentrate (from 82)

(The DM for rice bran and concentrates are both given as 90%. Adjust if the DM's are different).

3 kg of concentrate mix provide:

Feed	DM (g)	TDN (g)	DCP (g)
Concentrate (from 82)	$\frac{55}{100} \times 3,000 = 1,650$	$\frac{700}{1,000} \times 1,650 = 1,155$	$\frac{180}{1,000} \times 1,650 = 297$
Rice bran	$\frac{45}{100} \times 3,000 = 1,350$	$\frac{500}{1,000} \times 1,350 = 675$	$\frac{90}{1,000} \times 1,350 = 121$
Concentrate mix	**3,000**	**1,830**	**418**

So 3 kg DM or $\frac{100}{90} \times 3$ kg = 3.3 kg of concentrate mix is enough to meet the shortfall of TDN and DCP from fresh grass in 85 (page 24).

Notes (88-91)

- Ration calculations should be used only as a guideline. The nutritive value and the palatability of the same feedstuff can vary widely depending on a large number of factors. There are differences among individual animals, too, with regard to feed utilization.

However, feeding the animals based on a scientific method is definitely better than blindly offering whatever is available.

- Even in this particular example, if the cow does not eat 45 kg of fresh grass per day or if this quantity is not available, more concentrates will have to be offered to meet the shortfall in the nutrient supply.

- It is generally accepted that 1 kg of a good concentrate mixture supports the production of 2 kg of milk. However, when the amount of concentrates offered is increased, the amount of milk produced from each kg of concentrates de-creases (law of diminishing returns).

- This is particularly important when the difference between the prices of concentrates and milk is very small (or if the concentrates cost more than milk). On the other hand, if the animals do not receive sufficient nutrients, apart from low yields of milk other problems such as long calving intervals can arise due to the cows not conceiving regular-ly.

- Apart from the energy and protein supplies, mineral requirements also have to be supplied. A suitable mineral mixture should be provided either with the concentrates or as a separate lick.

Annex 1 Feeding dairy buffaloes

The countries where buffaloes are raised for both milk production and as draught animals have large animal populations. The feeding of stock is not always given proper attention. In India and Pakistan, buffaloes are raised mostly on crop residues. Part of the requirements are met through grazing stubble, canal banks etc. Green fodder is also produced and fed under the cut and carry system. The fodder is grown to such a stage of maturity that it provides lots of bulk but lacks nutrients. Rice and wheat straw are fed in plenty since year round supply of green fodder is not ensured.

Although buffaloes have shown excellent abilities for using crop residues, for satisfactory milk yield, an adequate fodder supply is essential during all stages of raising. For lactating animals adequate nutrients must be provided both for body maintenance and production. In good producers even ample green fodder may not fulfil all the requirements. Hence feed supplements/ concentrates are required.

After parturition even poorly fed buffaloes tend to maintain milk production for a few days at the expense of their body. This leads to poor production and shorter lactations.

In India and Pakistan and several other countries many village buffaloes are low producers because their requirements are not met. Much higher milk production potential has been demonstrated in well managed herds which produce over 3,000 litres of milk per lactation.

Good buffaloes produce 12-15 litres of milk per day and on average between 5-10 litres of milk per day. Higher producing animals must be provided with ample nutrients to maintain production as well as general health.

Buffalo can consume a variety of coarse fodders. For milk production 1 kg of concentrate is fed for 2 to 2.5 litres of milk produced. A ration could consist of green fodder + wheat straw + concentrate. Depending on the dry matter and TDN the green fodder, straw and concentrates must be adjusted.

60 to 70 kg of succulent fodders (Egyptian clover etc) would be fed to a buffalo weighing 500 kg. A single source of fodder may be deficient in nutrients such as legumes and require phosphorus supplementation. When a large quantity of wheat or rice straw is fed, Ca and P deficiency occurs.

For fodders with less maize, millet etc and high dry matter the quantity should be adjusted to between 20 to 30 kg per day along with some straw and concentrate. Avoid feeding coarse fodders to lactating animals. Silage or hay can also be efficiently used if available.

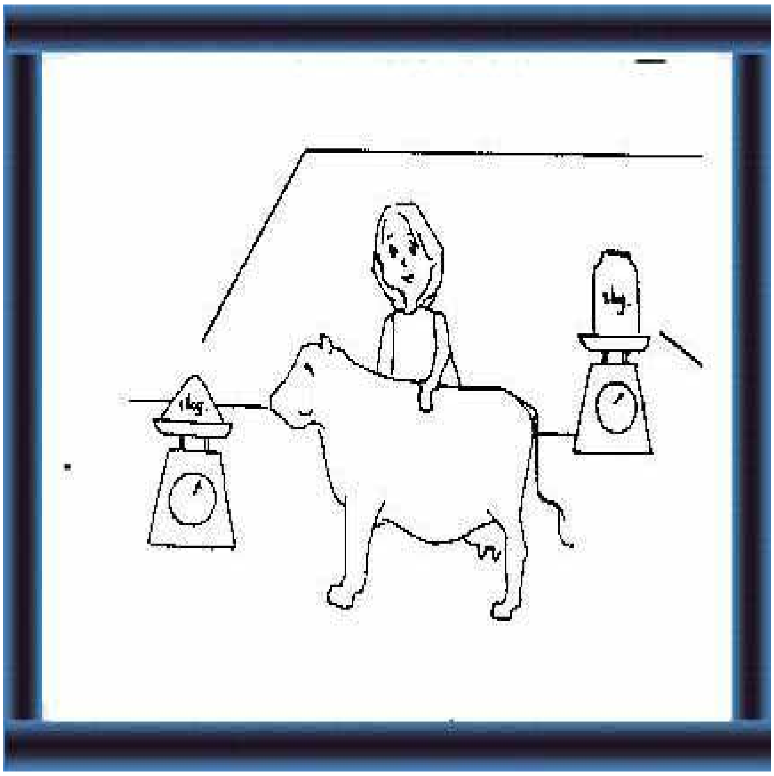
Feeding pregnant buffaloes

The ideal calving interval is 13-14 months. Owing to feeding and management practices, however, the animals tend to have a long calving interval with a long dry period. Since many pregnant buffaloes will not be producing any milk during the last part of pregnancy, these are not properly fed. During this period the buffalo should build up body reserves lost in early lactation. Nutrients are required for the fast growing foetus during the later stages of pregnancy. The body condition of the buffalo must be given proper attention. In addition to good fodder, 1 to 1.5 kg concentrate during the last part of pregnancy will help in attaining good foetal growth, health of buffaloes and a good start in subsequent production.

Important

88 Use these examples and calculations as **guidelines**.

Consult your extension worker when **planning feeds**.



89 You can **estimate** that 1 kg of good concentrate mix supports the production of 2 kg of milk, **but** increasing concentrates does **not** increase milk production at the same rate.

90 Calculate **carefully**:

- giving **too much concentrates wastesmoney**.

- giving **too little concentrates** may lead to **low milk yields** or **calving intervals**.

91 You should **meet your animal's mineral requirements** by:
- mixing with concentrates
- a separate mineral lick.

What do you know about feeding dairy cattle and buffalo?

Important points in feeding

1 Good feeding and breeding must go together for high milk production	**(5-8)**
2 Animals need:	
- nutrients for strength, health	**(9-10)**
- minerals for strong bones and joints	**(11)**
- proteins for strong muscles	**(12)**
- carbohydrates and fats for energy	**(13)**
- vitamins for proper body functioning	**(14)**
- to be fed the right amounts of the correct feeds	**(15-16)**

Digestion of feeds

1 The complex stomach	**(17-18)**
- abomasum	**(19)**
- rumen, reticulum, omasum	**(20)**

RATION CALCULATION WORKSHEET

Farmers name: Date:
Advisors name: Cow No:

INFORMATION REQUIRED **Weight of cow: kg Milk yield: kg/day** **Stage of lactation: months** **Butterfat %** **Age of cow: years Milk yield 4%FCM kg/day** **Dry matter intake: kg** **Gestation: months** **Feeds available: Lactation**	**A**

No: **a) on the farm:** **b) purchasable:**	
ANIMAL REQUIREMENTS **TDN** **kg Protein kg** **Maintenance:** **Desired weight gain:** **Milk production:** **Gestation:** **TOTAL:**	**B**
NUTRIENT CONTENT OF FEEDS AVAILABLE **Feed DM % TDN %** **Protein % Cost per kg** **1** **2** **3** **4** **5** **6** **7** **8** **9** **10**	**C**
FINAL RATION RECOMMENDED **Forage:** **Concentrate:**	**D**

Notes:

1 Desired weight gain: add 20 % to the maintenance allowance during the first lactation and 10 % during the second lactation.

2 At least 25% of DMI must come from forage to protect milk quality.

Table 1 :

The Estimated Dry Matter Intake of a Cow[1]

	MILK YIELD kg/day								
kg Live Weight	NIL	5	10	15	20	25	30	35	kg Live Weight
350	9.5	10.5	11.5	12.5	13.5	14.5	15.5	16.5	350
400	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	400
450	10.5	11.5	12.5	13.5	14.5	15.5	16.5	17.5	450
475	10.8	11.8	12.8	13.8	14.8	15.8	16.8	17.8	475
500	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	500
525	11.2	12.2	13.2	14.2	15.2	16.2	17.2	18.2	525
550	11.5	12.5	13.5	14.5	15.5	16.5	17.5	18.5	550
575	11.8	12.8	13.8	14.8	15.8	16.8	17.8	18.8	575
600	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	600
625	12.2	13.2	14.2	15.2	16.2	17.2	18.2	19.2	625
650	12.5	13.5	14.5	15.5	16.5	17.5	18.5	19.5	650
675	12.8	13.8	14.8	15.8	16.8	17.8	18.8	19.8	675

1) Formula used: DMI - 6 kg + 1% of body weight and 20% of milk yield.

Table 2 :

Daily Nutrient Requirements of Dairy Cattle - Heifers

Body Weight	Daily Gain	PROTEIN		ENERGY			
		Total	Digestible	NZ	TDN	Ca	P
(kg)	(g)	(g)	(g)	(Mcal)	(kg)	(g)	(g)
Growing Heifers (*mall broods)							
20	100	65	60	1.1	0.3	1.1	0.8
25	150	90	80	1.5	0.4	1.5	1.1
35	300	135	110	2.1	0.6	3.2	2.5
50	500	215	160	3.3	0.9	4.9	3.8
75	550	275	190	4.3	1.2	7	5.4
100	550	320	210	5.8	1.6	9	7
150	550	390	245	8.3	2.3	12	9
200	550	460	280	10.5	2.9	15	11
250	550	550	320	12.6	3.5	17	13
300	500	590	330	13.7	3.8	19	14
Growing Netters (large breads)							
40	200	110	100	1.8	0.5	2.2	1.7
45	300	135	120	2.1	0.6	3.2	2.5
55	400	180	145	3.3	0.9	4.5	3.5
75	750	330	245	5.4	1.5	9.1	7.0
100	750	370	260	7.2	2.0	10.9	
8.4							
150	750	435	295	9.8	2.7	15	12
200	750	500	330	12.3	3.4	15	14
250	750	570	365	14.4	4.0	21	16
300	750	640	395	16.2	4.5	24	15
350	750	715	430	17.7	4.9	25	19

Source: Nutrient Requirements of Dairy Cattle. 4th edition. 1971. National Academy of science. Washington.

Table 3:

Daily Nutrient Requirements of Lactating Dairy Cattle

Body Weight (kg)	ENERGY HE (Mcal)	TDN (kg)	PROTEIN Total (g)	Digestible (g)	Ca (g)	P (g)
Maintenance of Mature Lactating Cows						
350	10.1	2.8	468	220	14	11
400	11.2	3.1	521	245	17	13
450	12.3	3.4	585	275	18	14
500	13.4	3.7	638	300	20	15
550	14.4	4.0	691	325	21	16
600	15.5	4.2	734	345	22	17
650	16.2	4.5	776	365	23	15
700	17.3	4.8	830	390	25	19
750	18.0	5.0	872	410	26	20
800	19.1	5.3	915	430	27	21
Maintenance and Pregnancy (last 2 months of gestation)						
350	13.0	3.6	570	315	21	16
400	14.1	4.3	650	355	23	15
450	15.9	4.4	730	400	26	20
500	17.3	4.8	780	430	29	22
550	18.8	5.2	850	465	31	24
600	20.2	5.6	910	500	34	26
650	21.6	6.0	960	530	36	28
700	22.7	6.3	1000	555	39	30
750	24.2	6.7	1080	595	42	32
800	25.6	7.1	1150	630	44	34
Milk Production (nutrient required per kg of milk)						
PAT						
2.5	0.91	0.255	66	42	2.4	1.7
3.0	0.99	0.280	70	45	2.5	1.8
3.5	1.06	0.305	74	48	2.6	1.9
4.0	1.13	0.330	78	51	2.7	2.0
4.5	1.21	0.355	82	54	2.8	2.1
5.0	1.28	0.380	86	56	2.9	2.2
5.5	1.36	0.405	90	15	3.0	2.3
6.0	1.43	0.430	94	60	3.1	2.4

Source: Nutrient requirements of Dairy Cattle. 4 th edition, 1971, National Academy of Science. Washington

Note: for desired weight gain. Add 20% to the maintenance allowance during the first lactation and 10% during the second lactation.

Small-Scale

Dairy Farming Manual

Volume 3

Husbandry Unit 5.1

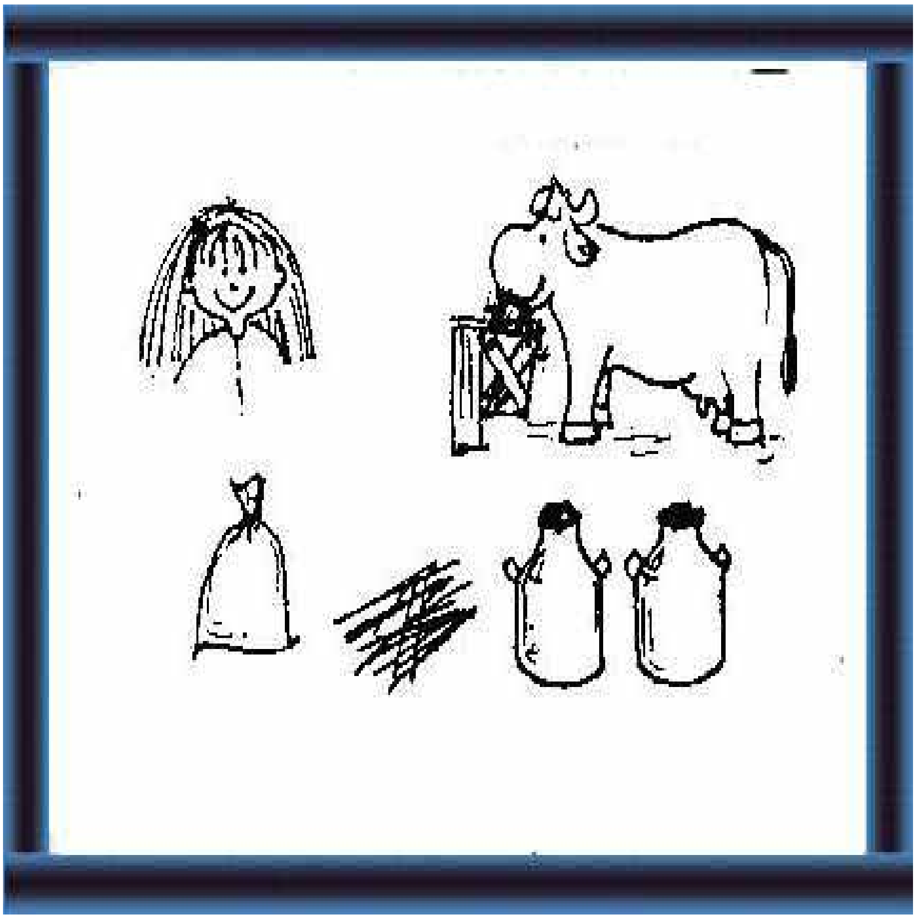
PASTURE AND FODDER

Extension Materials

What do you know about pasture and fodder?

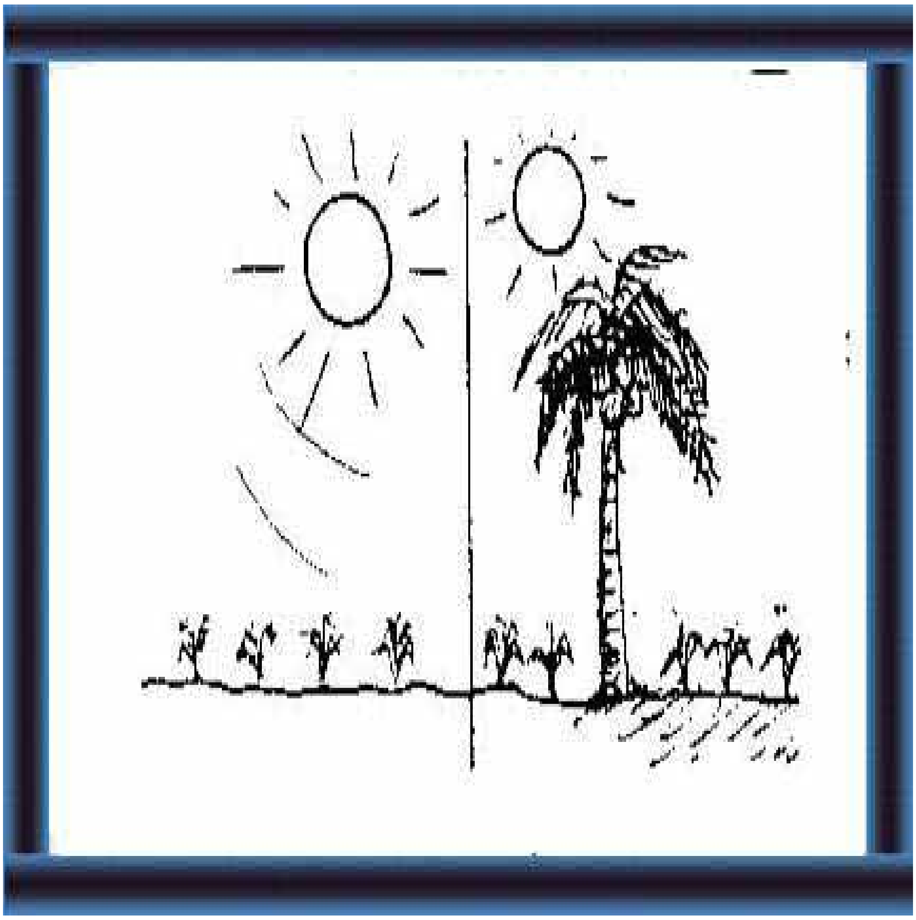
1 **Why do your animals need high quality roughages or concentrates? (5-8)**

Because they **cannot eat enough low value roughages** to give **good production**.



2 **How can you select suitable roughages? (9-26)**

You must think about important things e.g.:
- growth
- cost
- management
etc.



3 **What improved varieties are there? (27-31)**

There are many improved varieties of pastures, legumes, fodders to suit different conditions.

4 **How can you manage improved varieties? (32-57)**

You must plan management for:

- the type of pasture/ fodder
- your local conditions.

PASTURE AND FODDER

Husbandry Unit 5.1:

Technical Notes

Note: Numbers in brackets refer to illustrations in the Extension Materials.

Ruminants including cattle and buffalo have the ability to convert low value roughages such as grass and leaves of trees etc. to high value products such as milk, meat and hides etc. (5)

The ability of the animals to produce milk, meat etc. has increased over the years with the implementation of various selection and breeding programmes. But their ability to consume and utilize larger quantities of roughages has not increased in keeping with the increase in productivity. (6)

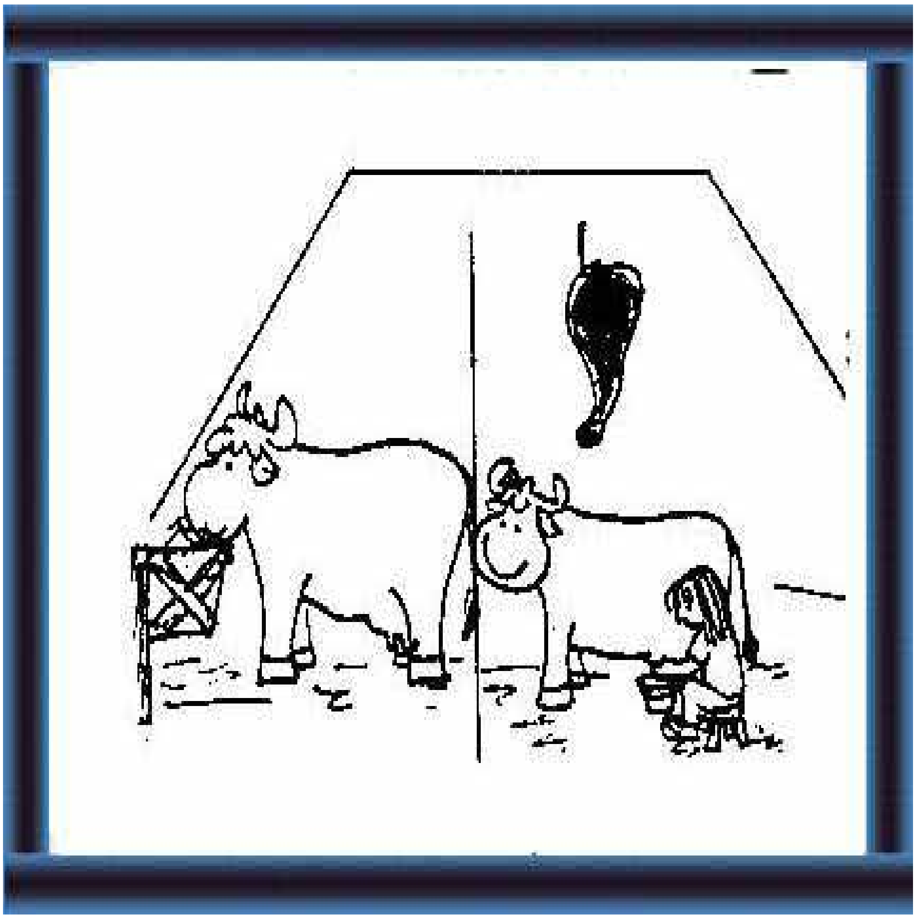
Therefore, animals capable of producing higher quantities of milk and meat have to be supplied with high quality roughages or concentrates, or both. (7)

In Asian countries, the roughages available to cattle and buffalo mostly come from crop residues and grasses and weeds etc. growing naturally in forests, roadsides and wasteland not utilized for growing various crops. Where animals with a capacity to produce larger quantities of milk are kept, the shortfall of nutrients available from roughages is met by offering concentrates. The concentrates are mostly crop residues and by-products.

In some areas, where income from dairying (or dairying in combination with meat production/draft) is sufficiently high, good quality roughages are cultivated for cattle/ buffalo feeding, sometimes as pure stands but mostly as

components of an integrated farming system (see Unit H.1.1). (8)

Why do your animals need high quality roughages or concentrates?



5 Dairy cattle and buffalo can change:

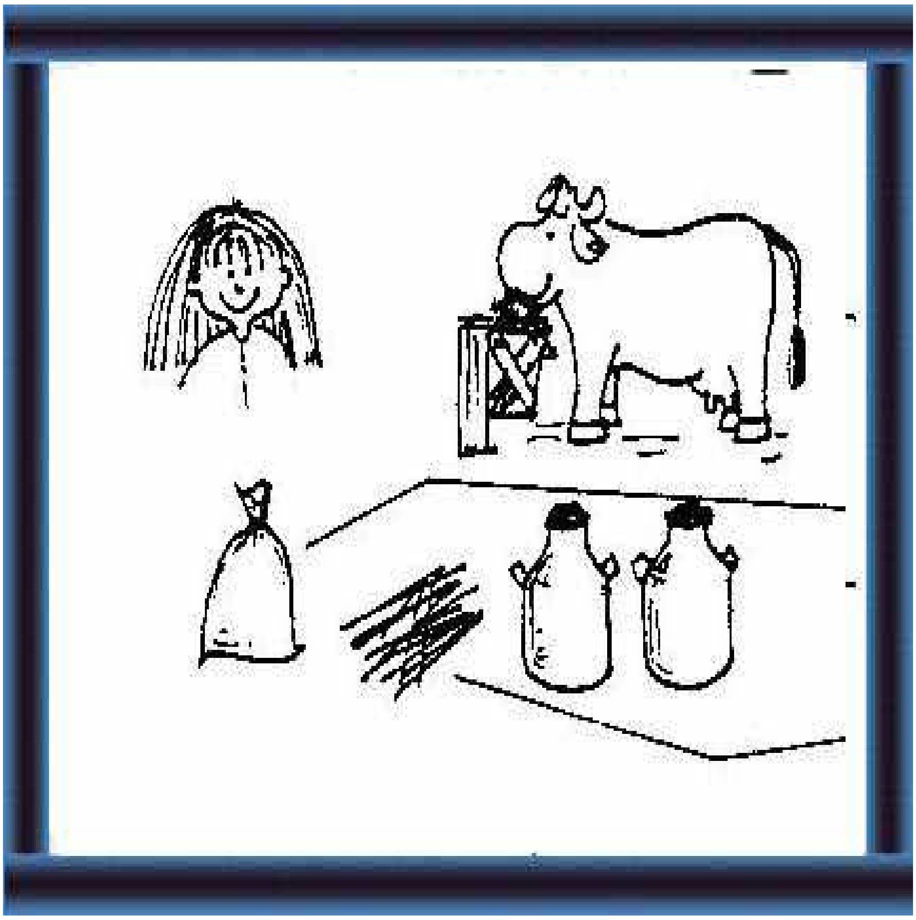
- **low value roughages** e.g. grass, leaves

- **to high value products** e.g. milk, meat.

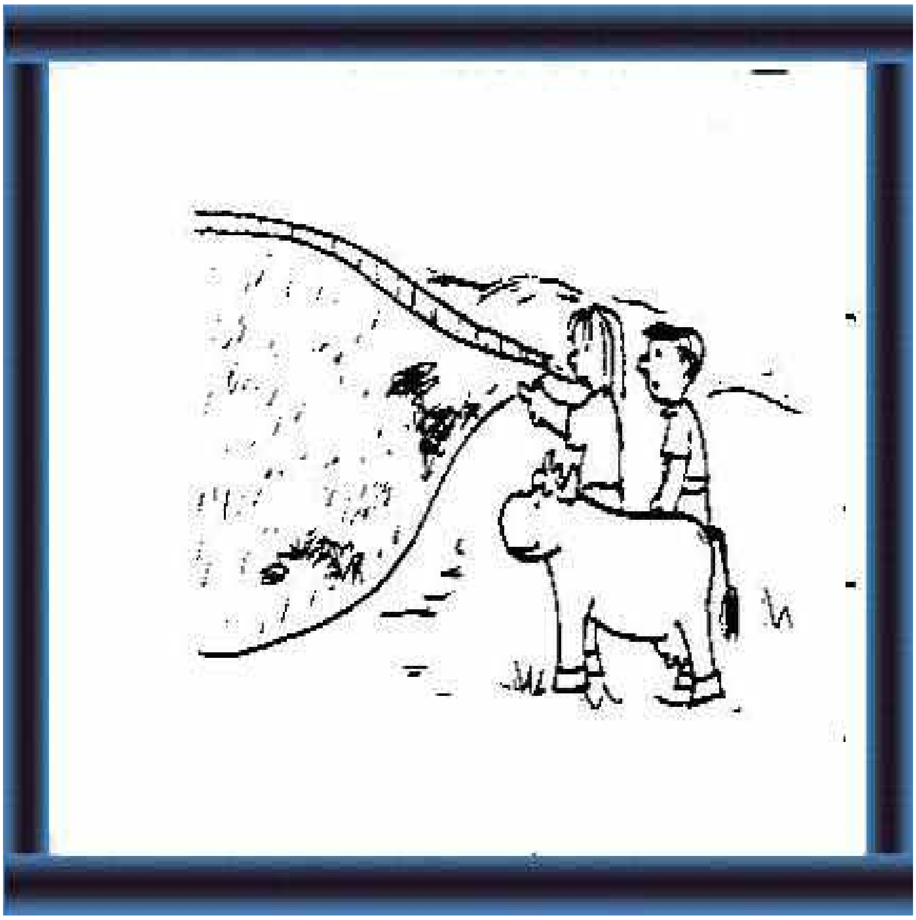
6 **With better breeding and selection:**

- your animals **can produce more but**

- they **cannot eat enough low value roughages** for production.



7 Therefore, you **must** give your animals **high quality**:
- roughages
- concentrates
- or both.



8 You should consult your extension worker about **growing good quality roughages**:
- alone
- or as part of an integrated farming system (see H 1.1)

Improved types of roughage

There are many improved pasture and fodder varieties that can be grown in Asian countries. However, only a few of them are particularly suitable to the conditions prevailing in any given area, e.g. the climatic conditions such as rainfall, length of dry season, elevation above sea level, soil conditions etc.

(Much research has been carried out on the suitability of various species for various conditions. The extension officer should acquire adequate knowledge on the recommended varieties for particular areas, especially with regard to the best establishment and management practices as well as the productivity that can be achieved).

In selecting a suitable variety, some important factors to

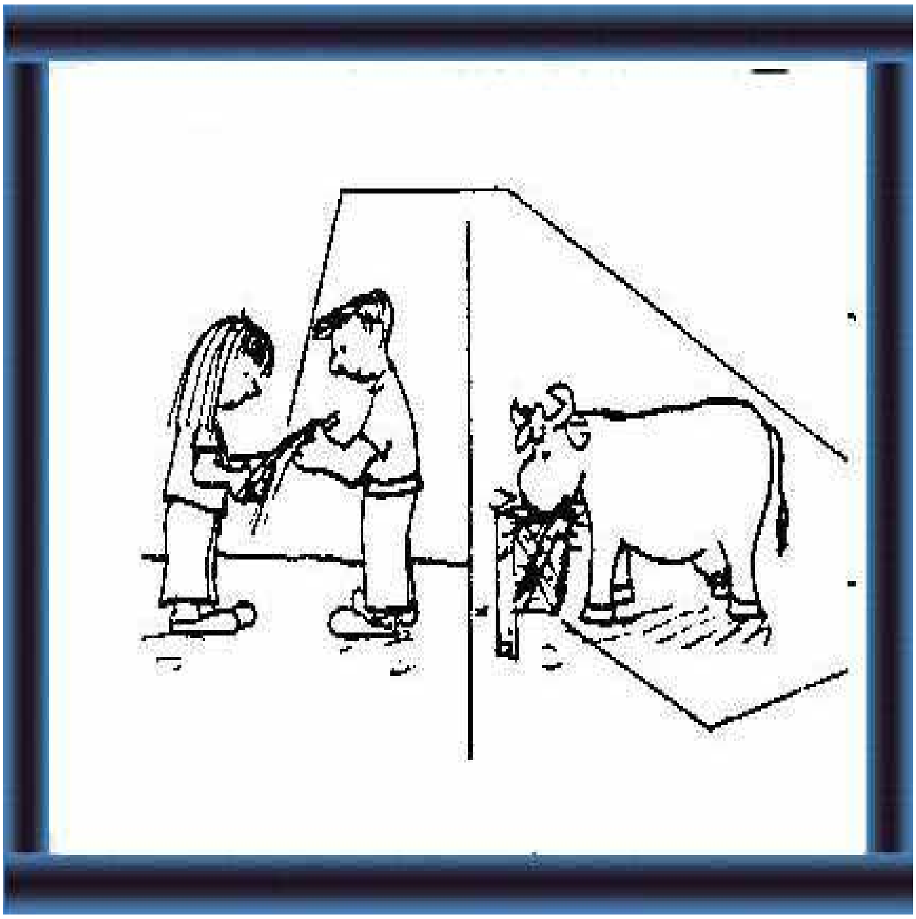
be taken into consideration are nutritive value, growth, persistence, ease of establishment and cost of maintenance. A variety with high nutritive values and good yields may be difficult to establish and costly to maintain. Therefore, the suitability of a particular variety will depend on the particular farmer's circumstances. (9)

Nutritive value: The nutritive value of pastures and fodders depends on the amount of energy, proteins, minerals and vitamins that the animals can obtain from them. This in turn depends on how much of the nutrients are contained in the pasture/fodder, how much of the pasture/fodder can be eaten by the animals voluntarily (palatability), how much of what is eaten by the animals can be digested and absorbed, and how much of what is absorbed is wasted e.g. if there are toxic substances, the animals will waste nutrients in overcoming their ill effects. (10-11)

Growth: The yield of dry matter (that part which contains the nutrients) of the pasture or fodder varies with the variety, under similar soil and climatic conditions. It is common to find varieties giving yields of 30,000 kg DM per hectare per year and some hybrid varieties of fodder such as hybrid Napier give much higher yields under good management, e.g. regular application of fertilizer and harvesting at appropriate intervals at appropriate height above ground level. (12)

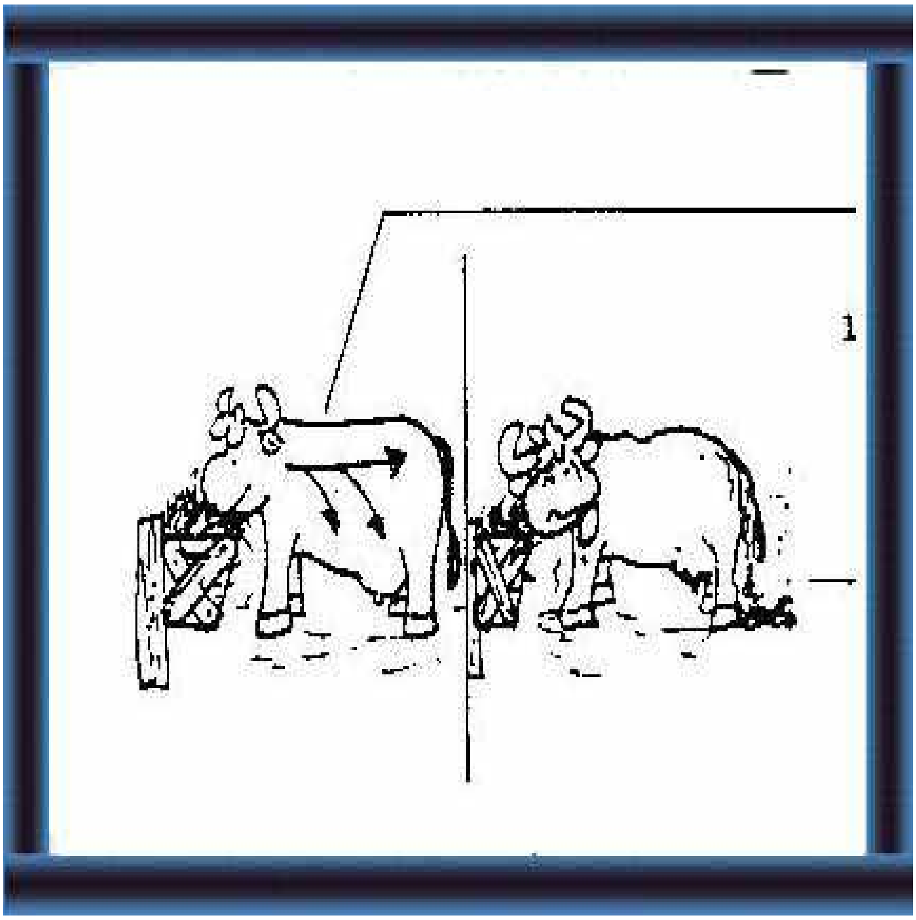
How can you select suitable roughages?

9 Your extension worker can advise you about suitable pasture and fodder crops for your area. Many things are important in choosing the **right crop** for you.



Nutritive value

10 This is **how much** energy, proteins, minerals and vitamins are:
- **in** the **pasture/ fodder**
- in the **amount** of pasture/ fodder your animals **can eat** (palatability)



11
- in the **amount** of pasture/ fodder your animals **can eat and absorb**
- not wasted because of bad feed causing ill effects.

Growth

12 You need:

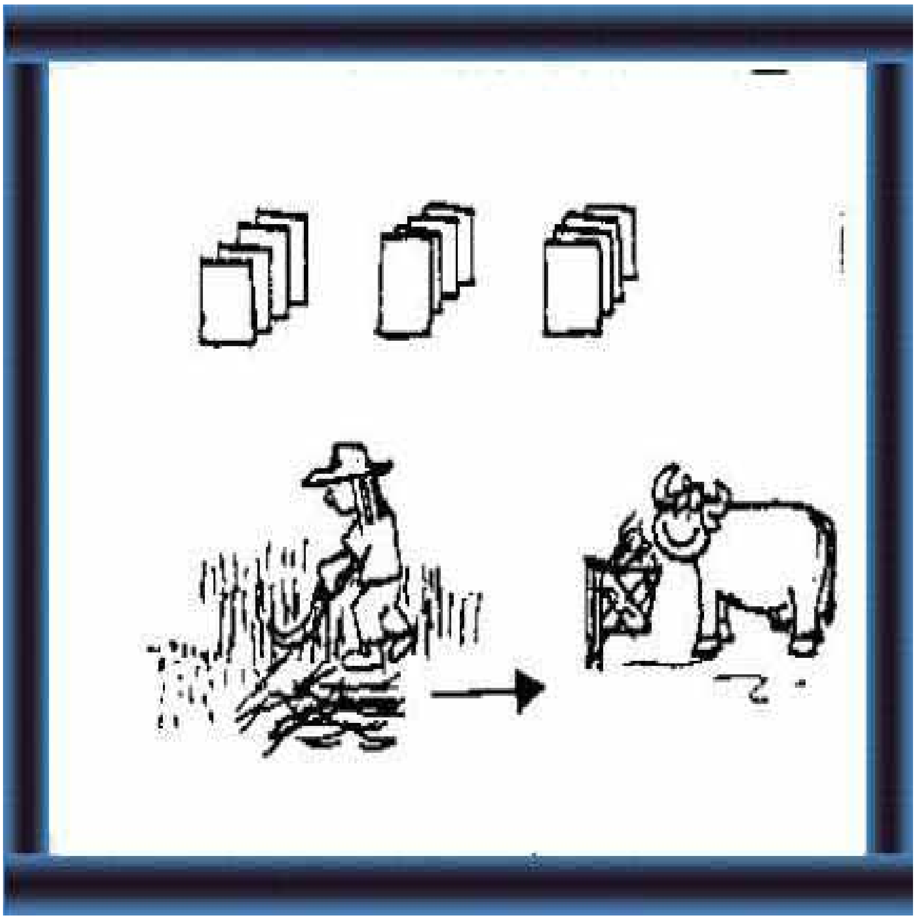
- **high yield of dry matter** (which contains nutrients) by e.g. using **fertilizer** and **harvesting** at the **right time**

Even though high annual yields are quite important, it would be advantageous to have this yield distributed over a long period of the year. If the yield is concentrated within a few months, additional expenditure has to be incurred on fodder conservation and there are also corresponding losses of nutrients. (13)

Persistence: **In Asia, it is common to use a pasture or fodder for several years continuously, once established. This practice reduces the costs of re-establishment. Varieties that continue to produce well, year after year, sometimes even under severe grazing, are said to have a high degree of persistence. These varieties are usually resistant to insects and other diseases and to extreme drought or cold, as the case may be. (14-15)**

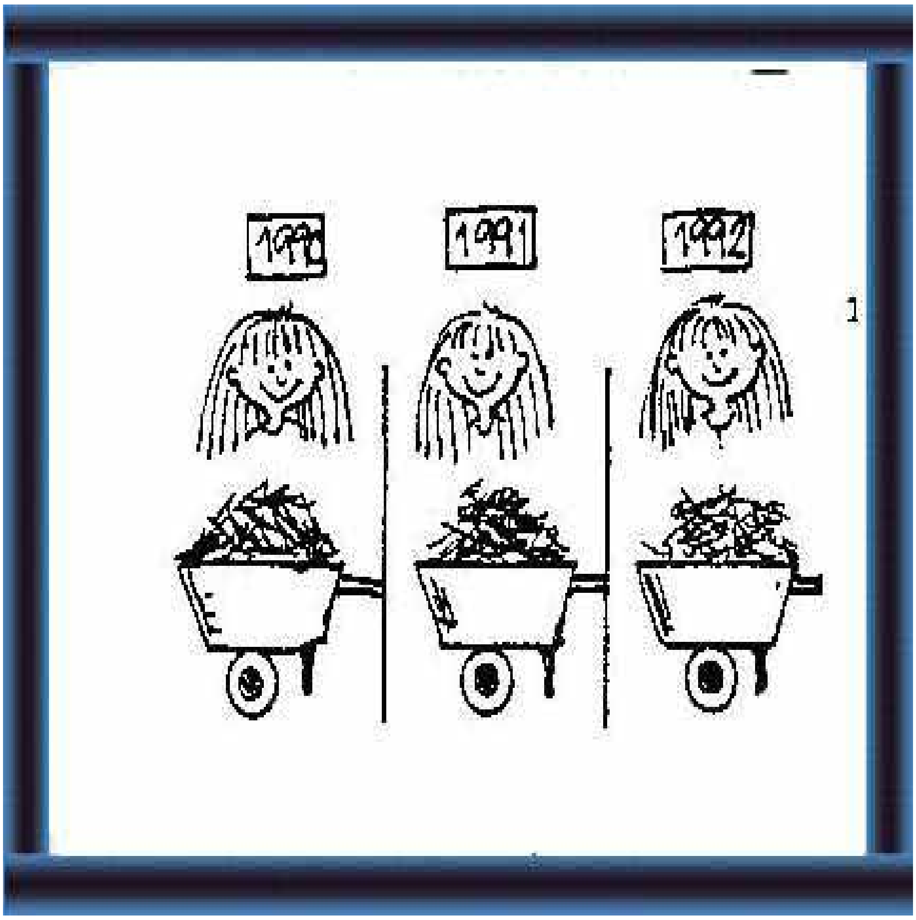
In varieties that spread by runners or rhizomes the growing points are inaccessible to the grazing animals. Therefore, they recover quickly even after continuous grazing. (16)

13
- the **yield over a long**



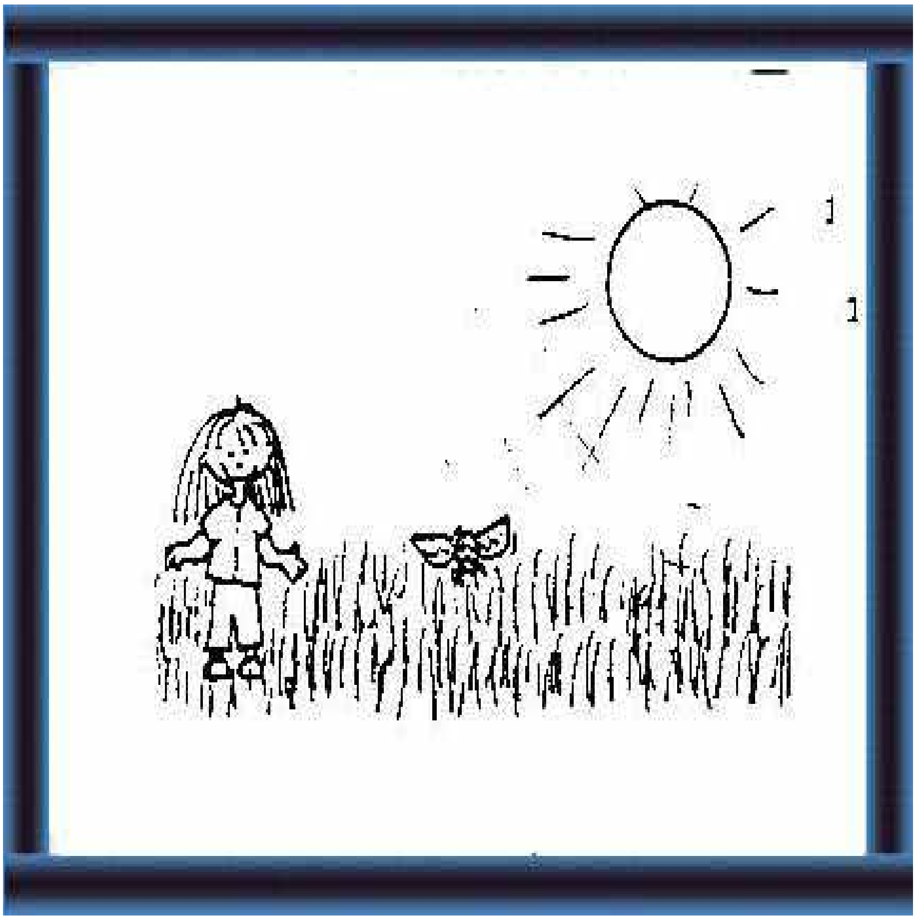
period of the year.

This **reduces** the **costs** of keeping fodder and the **loss of nutrients**.



Persistence

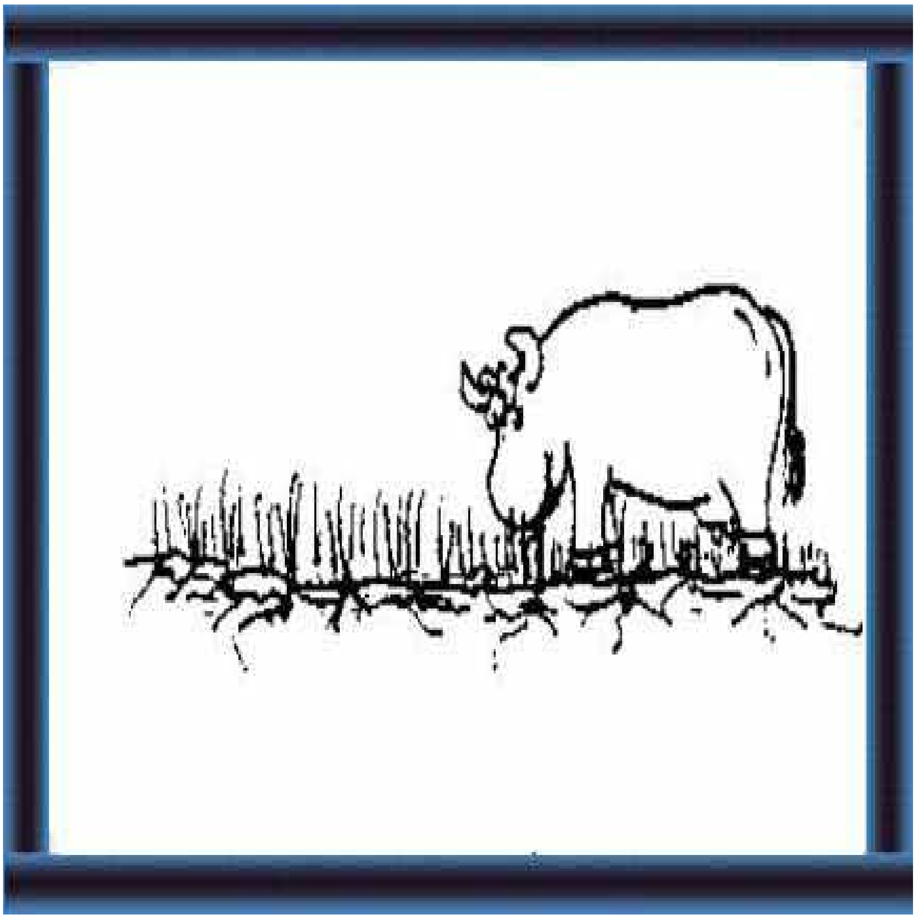
14 You need a pasture/ fodder that **produces well for many years**, even with heavy grazing.



This **reduces** the **costs** of planting a new crop (re-establishment)

15 The pasture/ fodder you choose should **resist**:

- insects
- disease
- drought etc.



16 Your animals **cannot eat** crops from **runners** or **rhizomes** because the growing points are **under** the ground. They recover quickly even after continuous grazing.

Ease of establishment: **Establishment of different varieties is effected through seeds or stem cuttings or root stocks. Different methods of establishment require different types of land preparation. (17)**

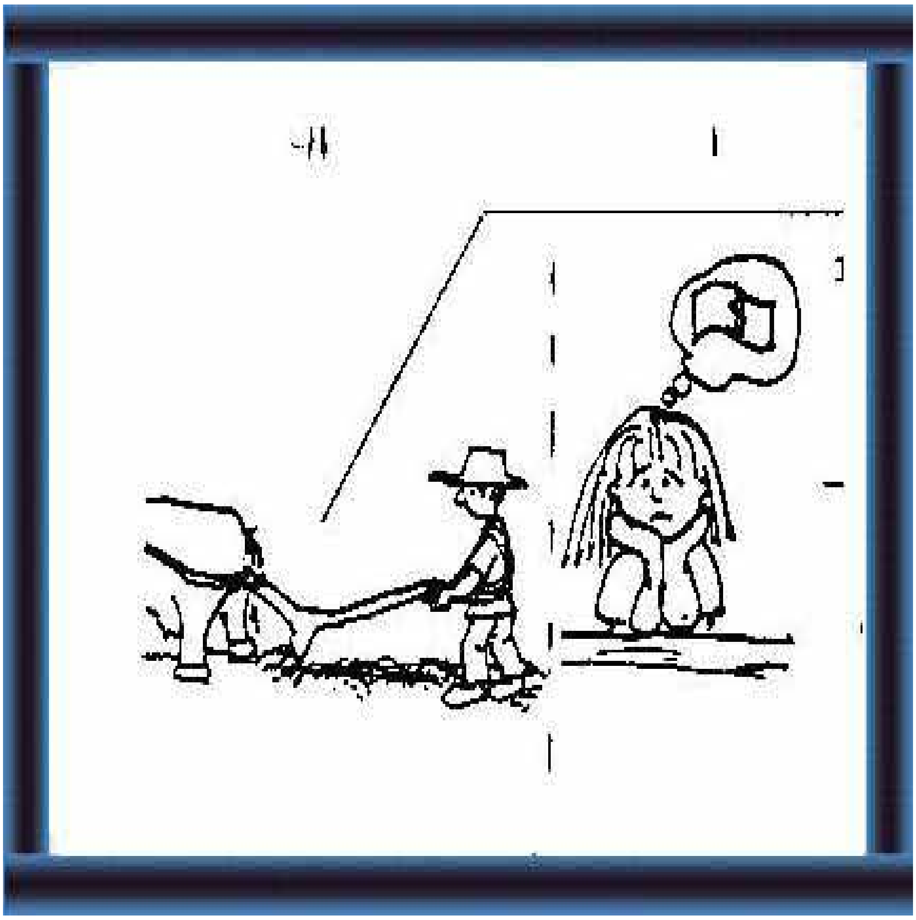
Therefore, in selecting a particular variety of pasture or fodder (or a combination of varieties) the methods of establishment and types of land preparation required and their costs have to be taken into account. (18)

Ability to associate (mix) with other crops: **There is no single variety of pasture or fodder that can supply the nutrient requirements of dairy cattle and buffalo in a balanced manner. The overall quality can be improved by having a mixture of varieties and also introducing a legume. (19)**

When pasture/fodder is a component of an integrated farming system, the ability of the species to survive in the mixture without causing losses to the other crops in the mixture is an important aspect. (20)

Ease of establishment

17 Land preparation depends upon the pasture/ fodder and whether it has seeds, stem cuttings or root stocks.

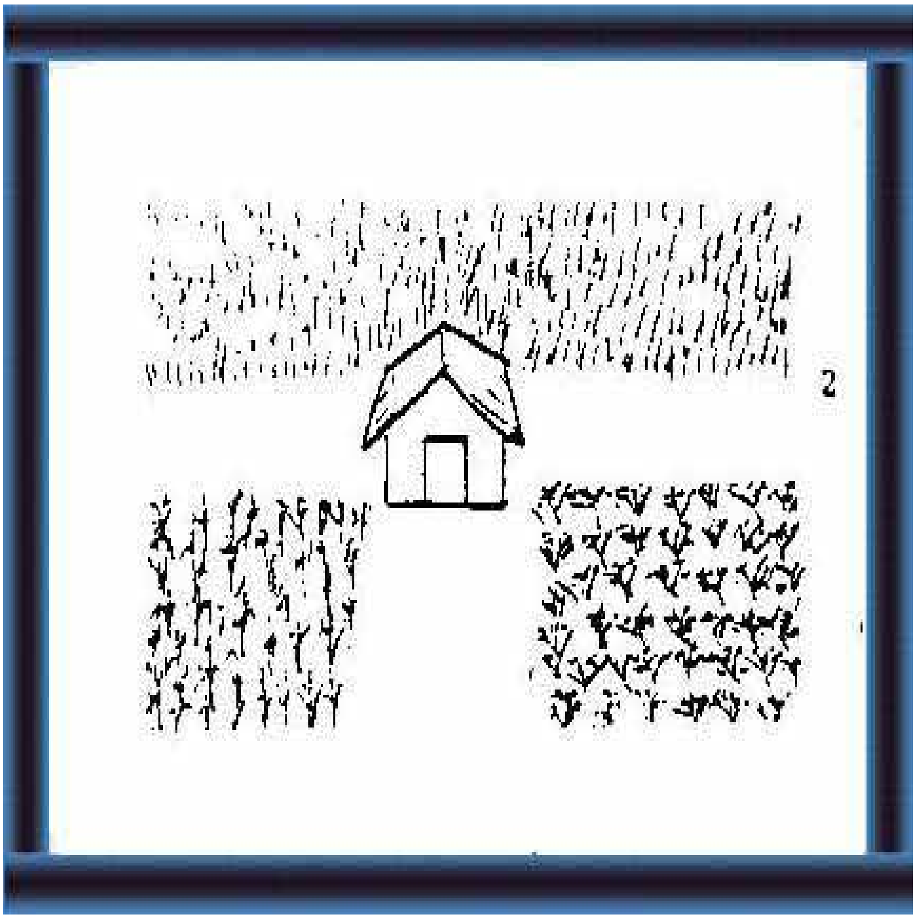


18 **Before choosing** a pasture/ fodder, **think about**:

- land preparation
- costs.

Ability to mix with others crops

19 You need **different** pasture/ fodder crops (including a legume) to **meet** your animals' **nutrient requirements**.



20 You must choose crops which **grow together well**. (See H1.1 Integrated Farming Systems)

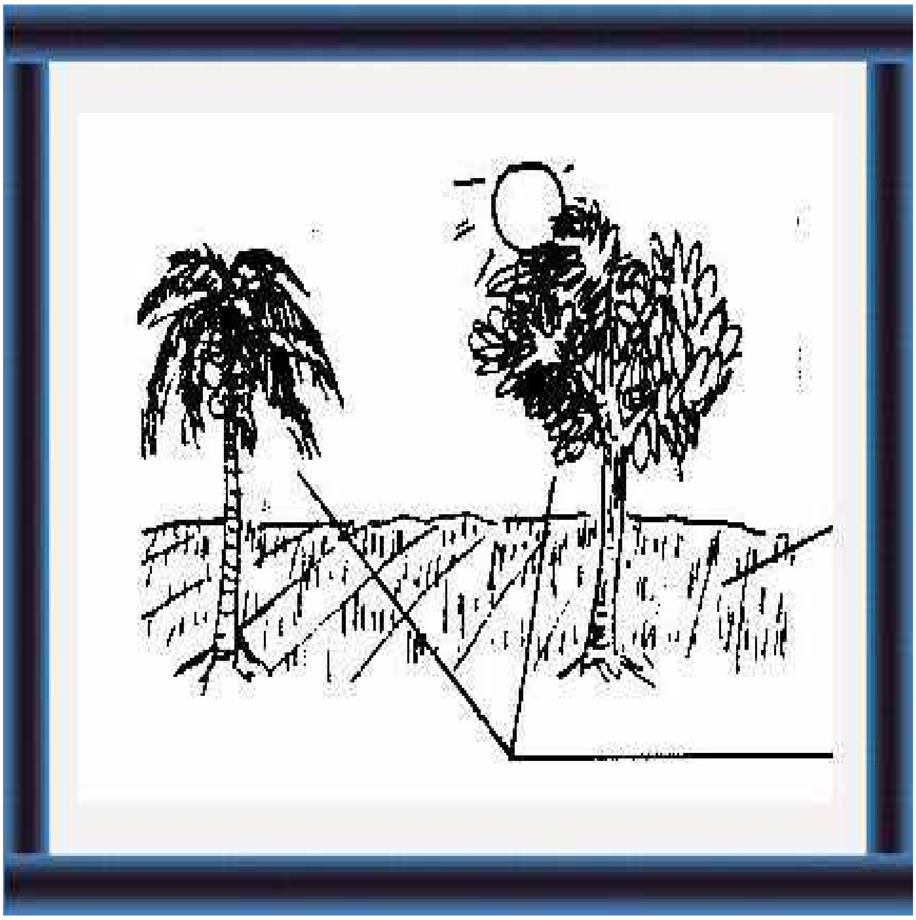
Examples of competition between pasture/fodder and other crops are:

- competition for sunlight; reduced sunlight is available for pasture/fodder growing under permanent crops like coconut, rubber etc.; (21)

- competition for moisture and fertilizer; pasture/fodder growing together with other crops may compete for moisture and fertilizer unless there is sufficient rainfall and addition of fertilizer to meet the requirements of the crops and the pasture/fodder. (22)

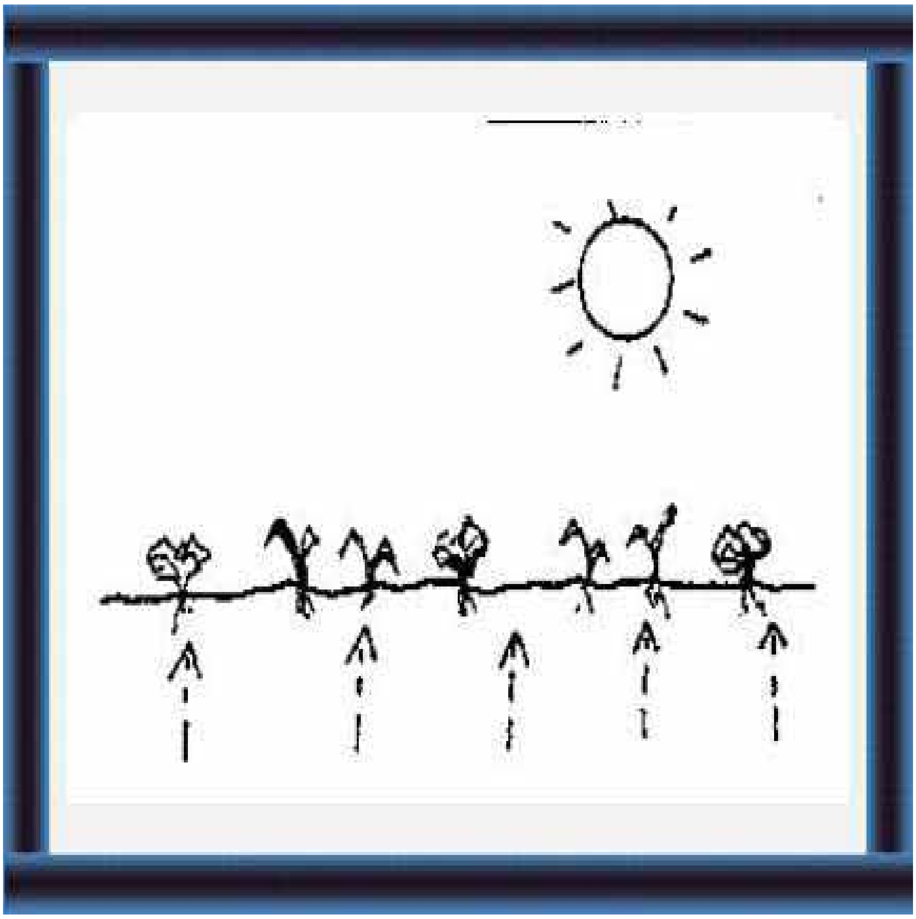
Cost of establishment and maintenance: Cost of establishment and maintenance is a very important aspect to be taken into account in making a decision on pasture/ fodder establishment. Generally the more nutritious and higher yielding varieties are more costly to establish and maintain, and require higher management skills. (23)

However, when land is scarce and expensive, returns from dairying are sufficiently high, and suitable varieties are available to meet the local agro-ecological (environmental) conditions, it may be more profitable to use more nutritious and higher yielding varieties. (24)

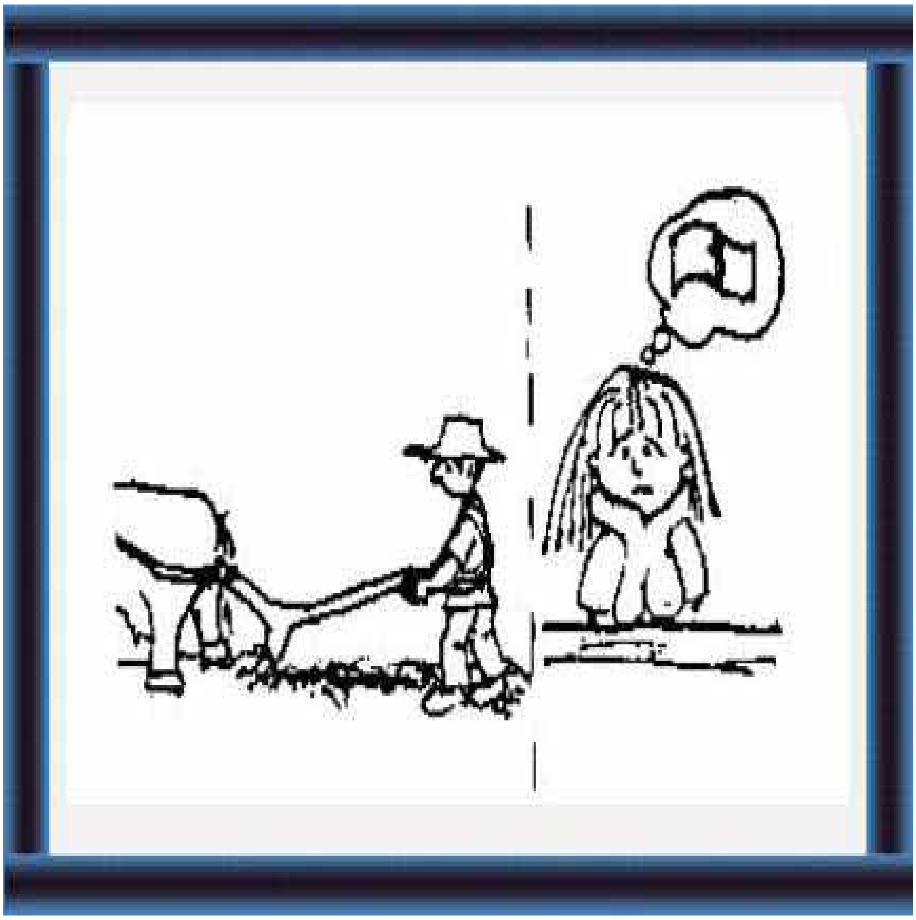


Be careful, some crops **compete**:

21
- for sunlight e.g. pasture/ fodder growing under coconut, rubber etc.



22
- for moisture and **fertilizer**, unless there is **enough rainfall** and you **add fertilizer**.



Cost of establishment and maintenance

23 You must **balance**:
- the **cost** of establishing, maintaining and managing fodder/ pasture with **high** nutrients and yields

against

24
- the **extra** nutrients and yields you gain.

Other benefits: **Apart from serving as a feed resource, especially for cattle and buffalo, there are other benefits from pasture/fodder.**

These include:

- building up soil fertility in lands that have been used continuously for crop production over a number of years ("ley" farming technique); (25)

- addition of fertility to the soil by incorporation of legumes together with pasture/fodder;

- prevention of soil erosion. (26)

Among the improved pasture varieties are:

Brachiaria brizantha (Signal grass); Brachiaria decumbens; Brachiaria milliformis; Brachiaria mutica (Para grass, Water grass), Brachiaria ruziziensis (Ruzi grass); Cenchrus ciliaris (Buffel grass); Cynodon species; Dactylis glomerata (cocksfoot); Digitaria decumbens (Pangola grass); Panicum maximum (Guinea grass); Panicum maximum (Hamil grass); Paspalum plicatulum; Paspalum urvillei; Pennisetum clandestinum; (Kikuya grass); Setaria sphacelata; Tripsacum laxum (Gautamala grass) etc.

The different varieties are more suitable for certain particular conditions.

Some examples are:

- Brachiaria brizantha for low rainfall conditions;

- Brachiaria milliformis for shade conditions such as found under coconut; (27)

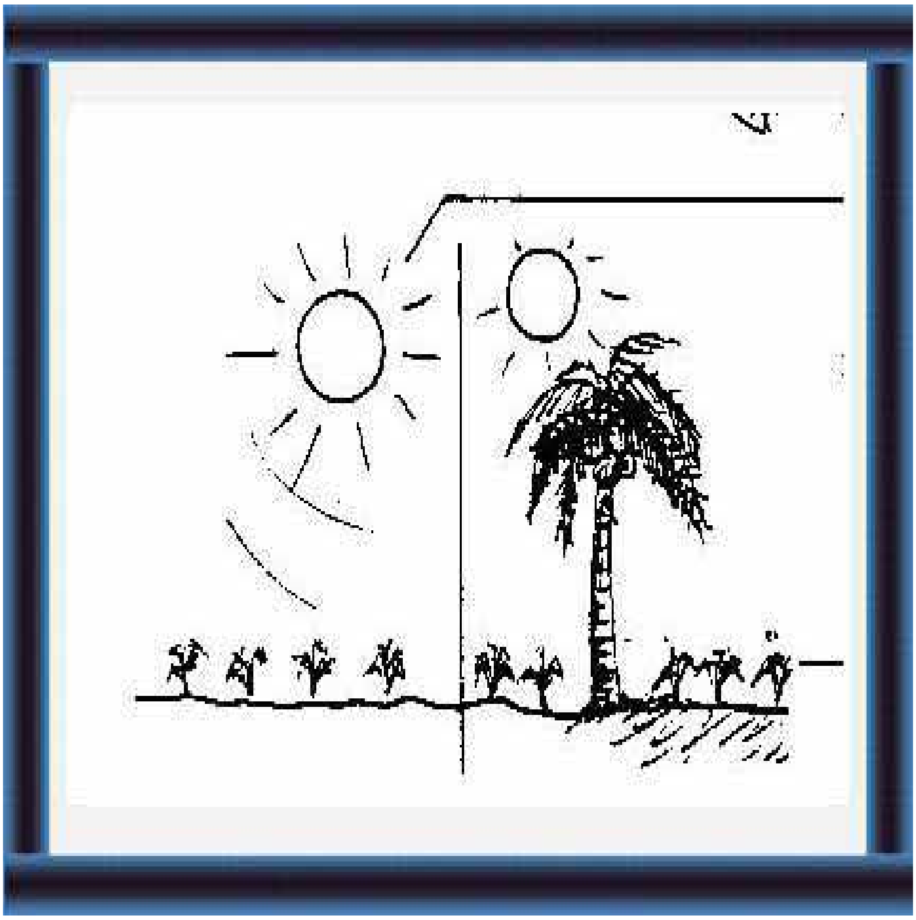
- Brachiaria mutica for water logged conditions;

- Brachiaria ruziziensis, suitable also as a fodder in high rainfall areas with well drained soil; (28)

Other benefits
25 These include:
- building up soil fertility where you used fields for crop production for many years ("ley" farming technique)

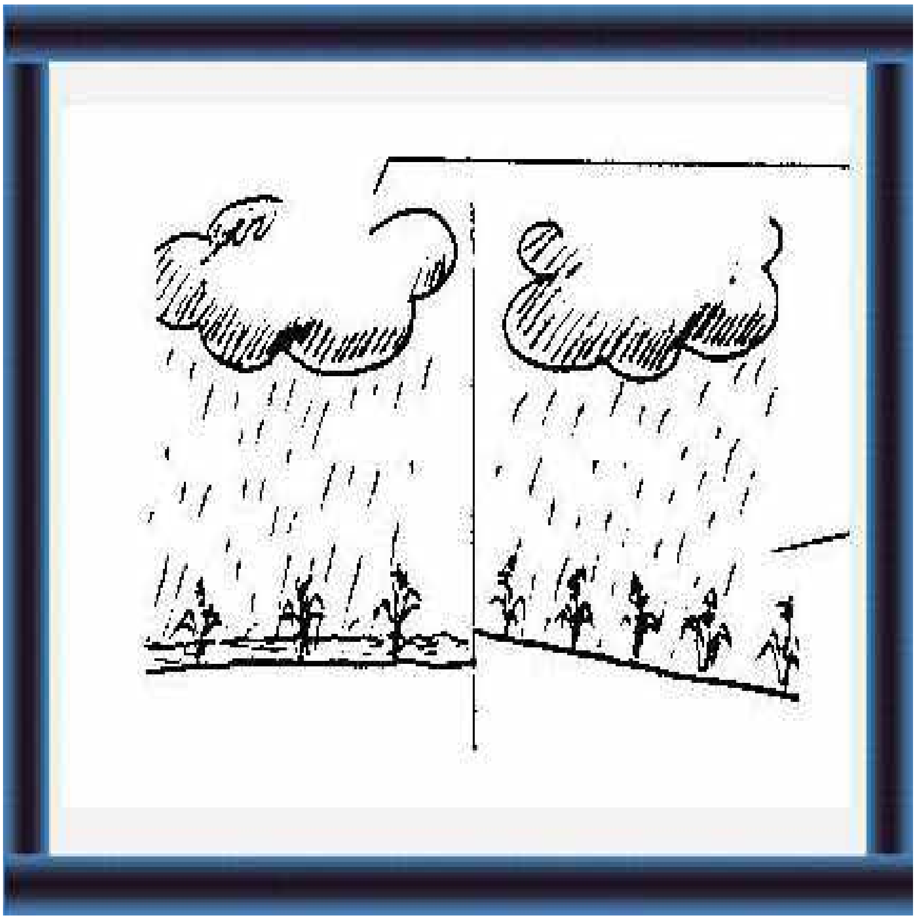
- **increasing fertility** by using legumes with pasture/ fodder

- **preventing soil erosion**.



What improved varieties are there?
See Annex I for a list.
Pasture

27 Different varieties are suitable for certain conditions e. g.:
- Brachiara brizantha for **low rainfall** conditions
- Brachiara milliformis for **shade** e.g. under coconut



28
- Brachiara mutica for **water logged conditions**
- Brachiaria ruziziensis for **high rainfall with well-drained soil**

- Pennisetum clandestinum and Paspalum varieties for cool climates in areas with high altitude and high rainfall. (29)

Improved legume varieties

Among the improved legume varieties are:

Centrosema pubescens; Desmodium intortum (Green leaf desmodium); Desmodium uncinatum (Silver leaf desmodium); Dolichos axillaris; Dolichos lab lab (lab lab bean); Gliricidia maculata; Glicine javanica; Glicine wightii; Leucaena leucocephala (ipil-ipil); Phaseolus atropurpureous (Siratro); Pueraria phaseoloides (Tropical Kudzu); Stylosanthes guyanensis (Cook stylo); Stylosanthes hamata; Stylosanthes humilis (Townsville lucerne); Styzolobium atterimum (Velvet bean); Trifolium pratense (Red clover); Trifolium repens (White clover);

Trifolium rupellianum (African clover); Trifolium semipilosum (Kenya white clover).

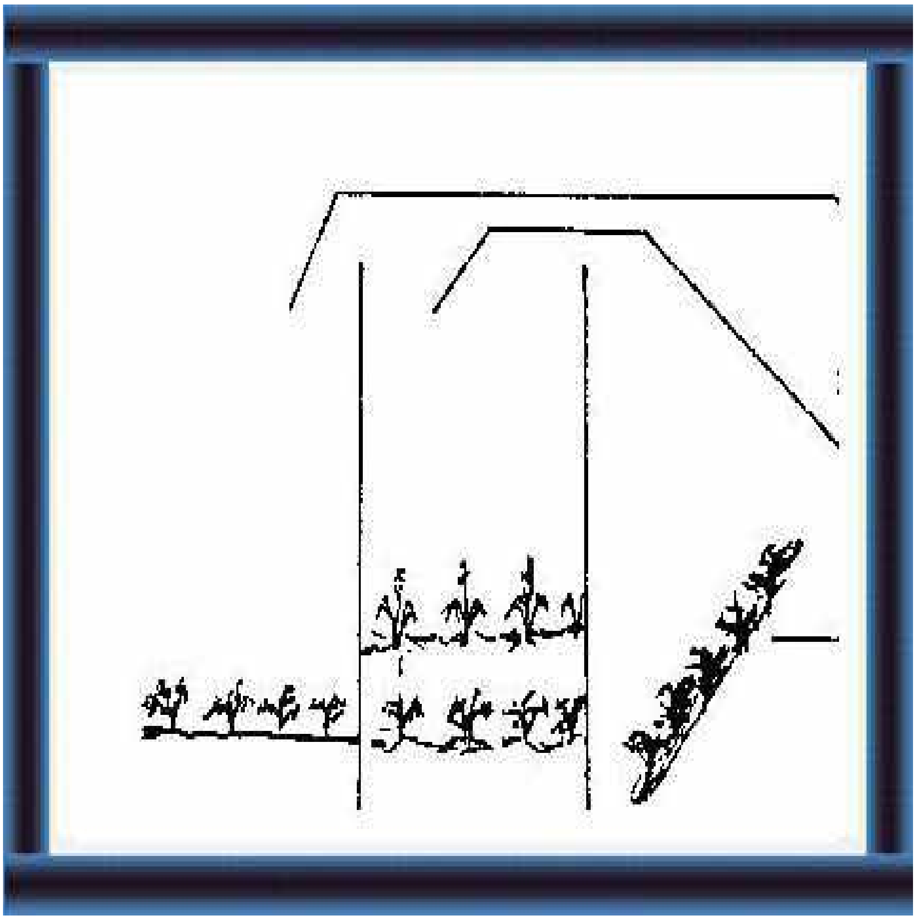
The legumes may be established as pure stands, as components in mixture with other crops as grasses, or as fences or hedges. (30)
Improved fodder varieties

Some of the varieties listed under pastures and legumes can also be used as fodders, e.g. Brachiaria ruziziensis; Panicum varieties; Paspulum varieties; Glyricidia; Leucaena etc.

Some varieties that are used mainly as fodders are, Pennisetum purpureum (Napier grass or Elephant grass) and its newly developed hybrids such as "NB 21" or Poosa Giant Napier"; fodder maize varieties and newly developed hybrids; fodder sorghum varieties and newly developed hybrids etc. (31)

29
- Pennisetum clandestinum and Paspalum

varieties for **cool climates**, **high altitudes** and **high rainfalls**.



Legumes

30 You can grow legumes:

- alone
- with other crops
- as fences or hedges.

Fodder

31 You can also use some varieties of pastures and legumes as fodders e.g.:
- Brachiara ruziensis
- Panicum varieties
- Leucaena etc.

Land preparation

The conventional land preparation methods consist of ploughing the land to break up and loosen the soil, followed by harrowing to further loosen the soil clods into smaller soil particles and for thorough incorporation of the plant materials into the soil. The number of ploughings and harrowings will depend on the soil condition and the type and density of the weeds present at the time of ploughing. (32-33)

Generally, species with small seeds require a finer soil than those with large seeds. The species propagated by rootstocks, stem cuttings or stolons may be planted immediately after ploughing on rougher soil surfaces. (34)

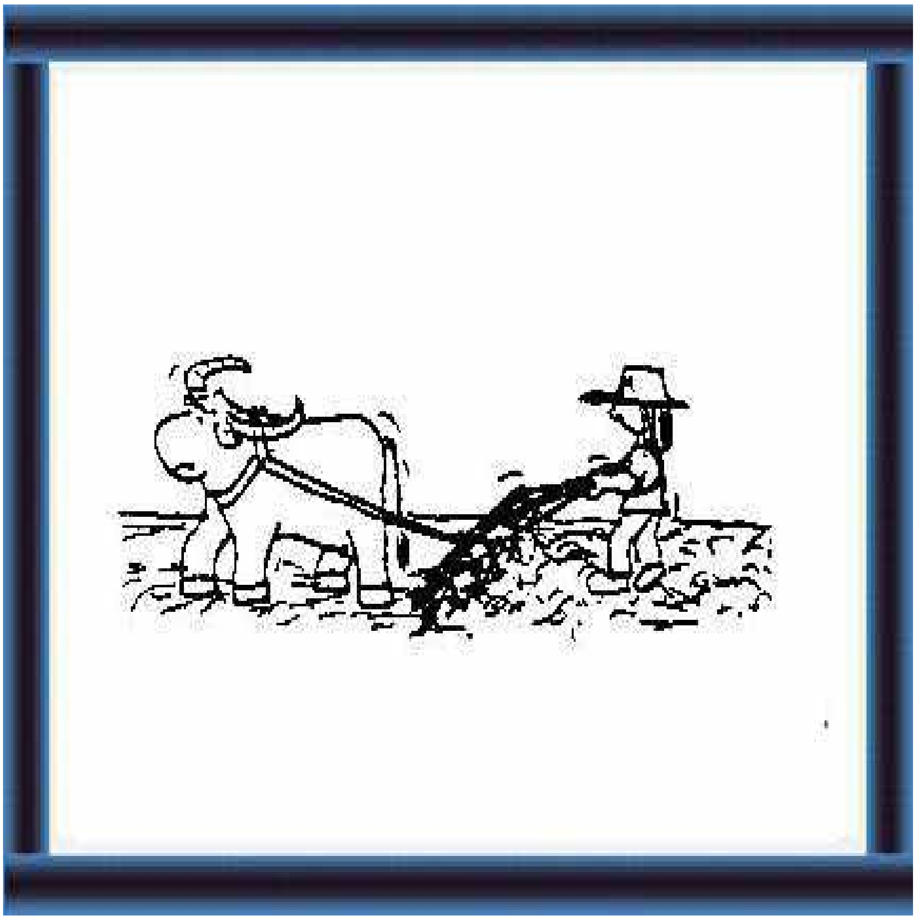
In high rainfall areas, sloping land especially is not

suitable for fine seedbed preparation because of the possibilities of severe soil erosion. (35)

How can you manage improved varieties?

Land preparation

32 You need to:
- **plough** to break up and loosen the soil



33
- **harrow** to further break up and loosen the soil and mix plant materials with the soil.

34 You can plant rootstocks, stem cuttings or stolons after ploughing. Varieties with smaller seeds need finer soil (more harrowing).

35 In areas with high rainfall and especially sloping land do **not** make a fine seedbed: - this causes **soil erosion**.

Method of planting

Methods of planting depend on the planting materials used.

When propagation is by seed, one of following methods may be used:

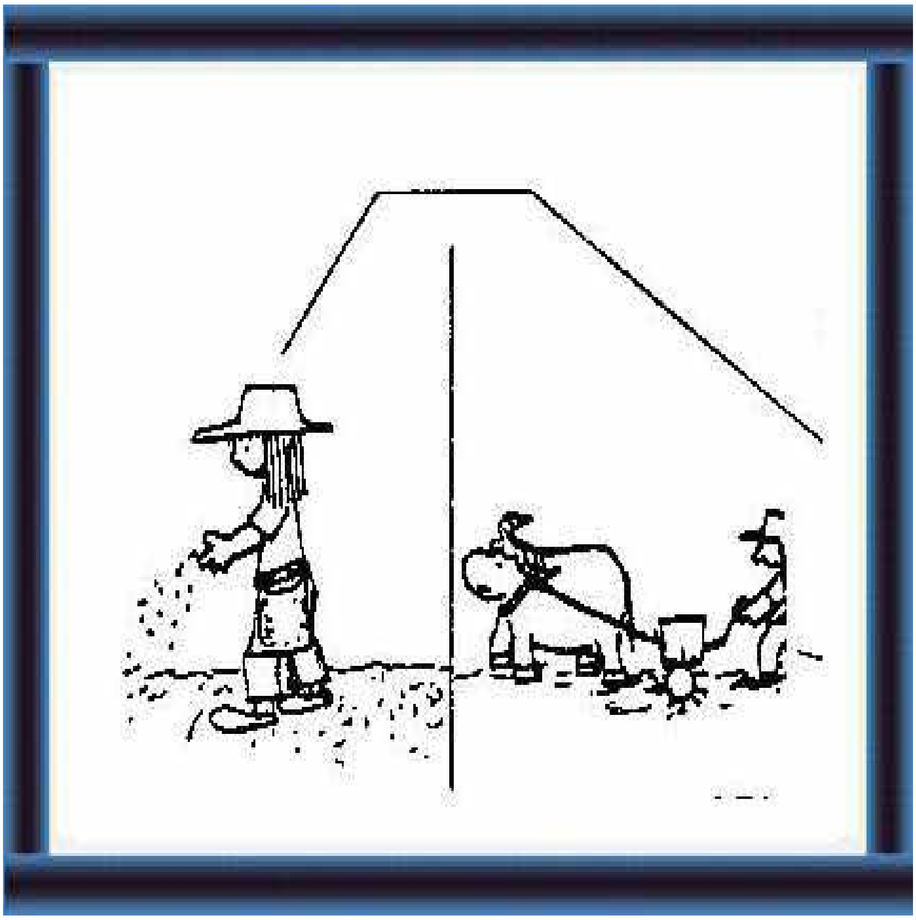
- broadcast by hand
- sown with fertilizer distributor
- drilled with a seed drill. (36)

Grass seeds need to be embedded at depths varying from 0.75 to 1.25 cm and seeds of big-seeded legumes can be embedded down to 7.5 cm depending on soil moisture. (37)

When propagation is by vegetative methods, the follow-ing procedures may be adopted:

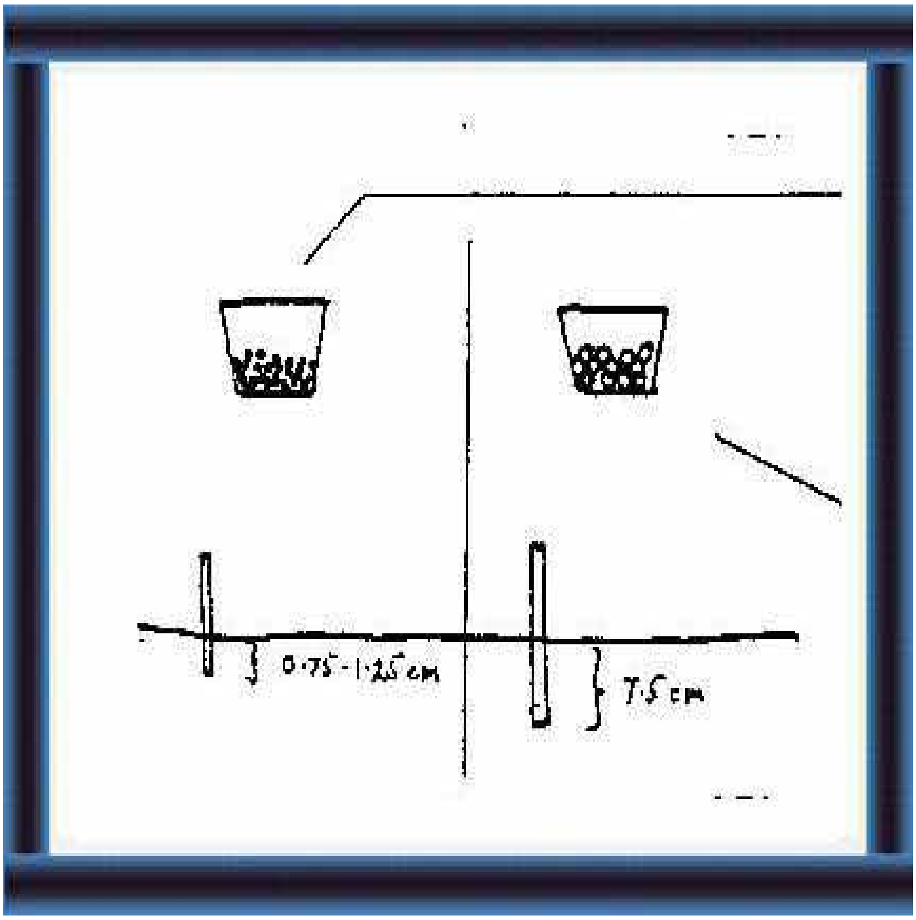
- stem cuttings (e.g. Napier grass) with 2 or 3 nodes may be planted by hand using a hoe or plant-ing pick, by sticking the stem in an inclined position; (38)

- an alternative method is to lay the stem cuttings in shallow furrows at a suitable depth depending on soil type and moisture conditions and cover with soil by a plough or mammoty. (39)



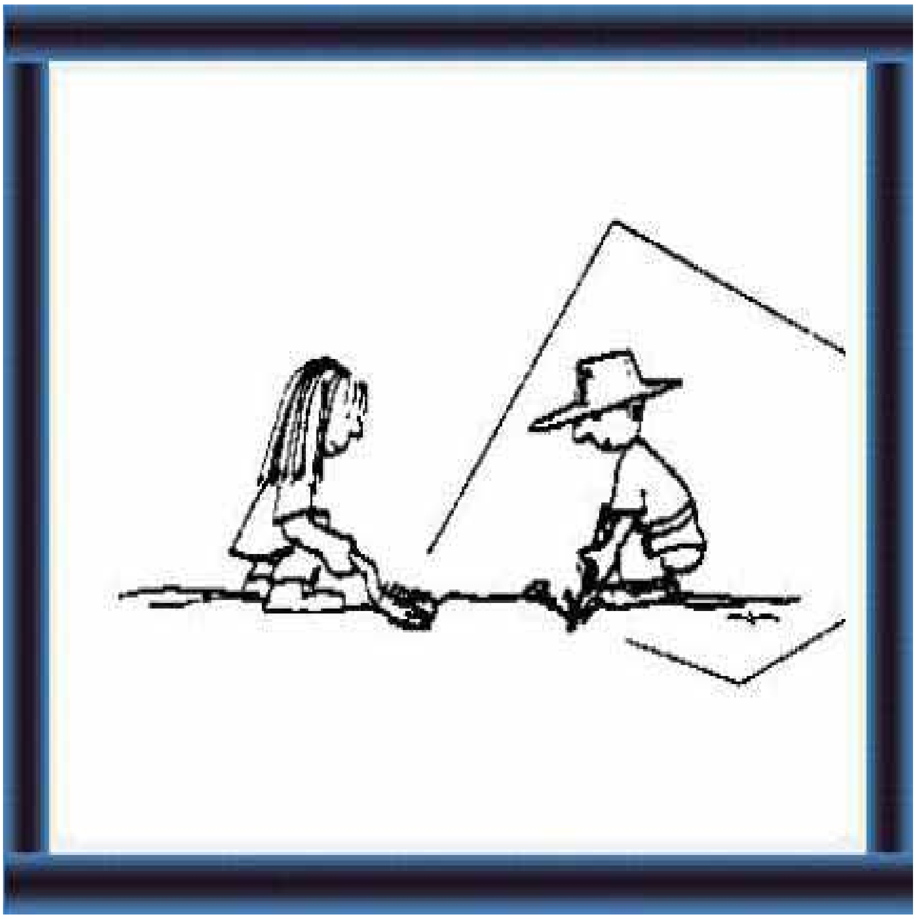
Methods of planting

36 This depends on **planting materials**:
Seed propagation:
- broadcast by hand
- sow with fertilizer distributor
- drill with seed drill.



37 Place grass:

- seeds at a depth of 0.75 to 1.25 cm - legumes with large seeds at depth up to 7.5 cm depending on soil moisture.



38 **Vegetative propagation:**

Stem cuttings e.g. Napier grass with 2 or 3 nodes:
- use a hoe or planting pick to make a hole
- put the stem in at an angle
or

39
- lay the stem cutting in shallow furrows
- cover with soil by plough or mammoty.

- tufts or rootstocks with 3 to 5 tillers (e.g. Guinea grass) may be planted by hand using a hoe at 25 x 25 cm intervals; (40)

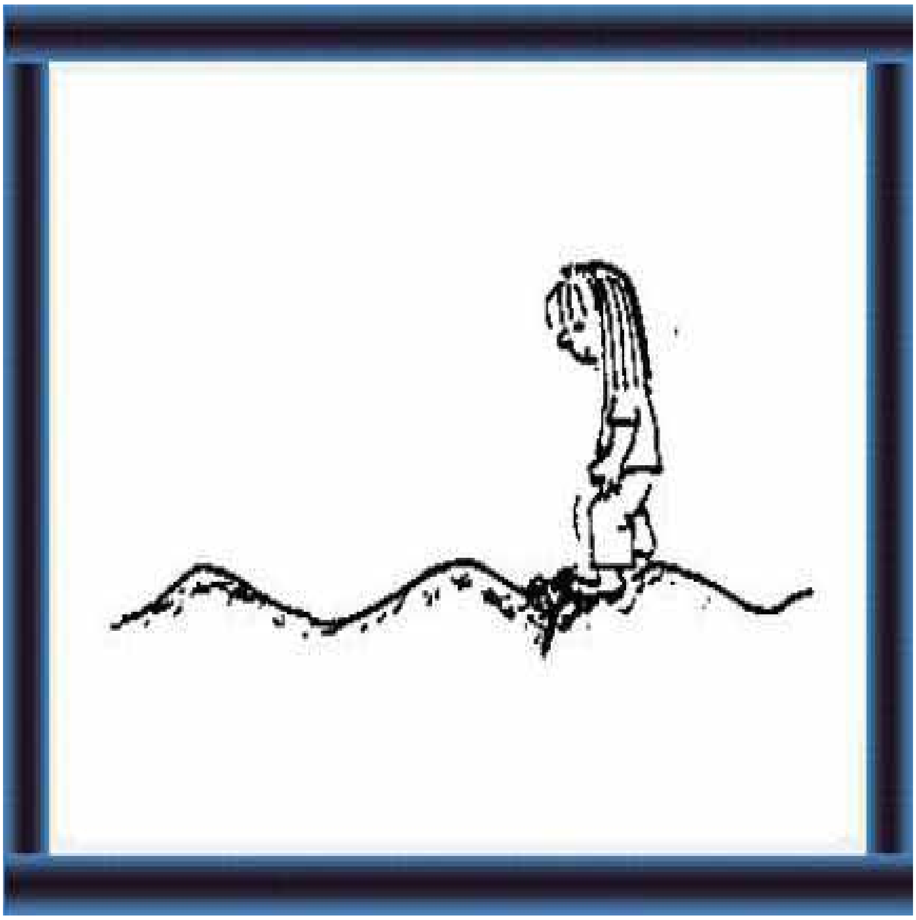
- an alternative method is to plant in furrows and cover by pushing the soil with the help of the foot. (41)

- Pieces of rhizomes or stolons (e.g. Brachiaria species) may be planted by spreading them on loose seedbed and pushing into the soil with the foot or by driving a cart or tractor over them; (42)
alternative methods are:

- to scatter mature cuttings on the surface of seedbed and run a disc harrow over them (under wet conditions); (43)

40 **Tufts or rootstocks** e. g. Guinea Grass with 3-5 tillers:
- plant with a hoe at 25 x 25 cm spacing
or

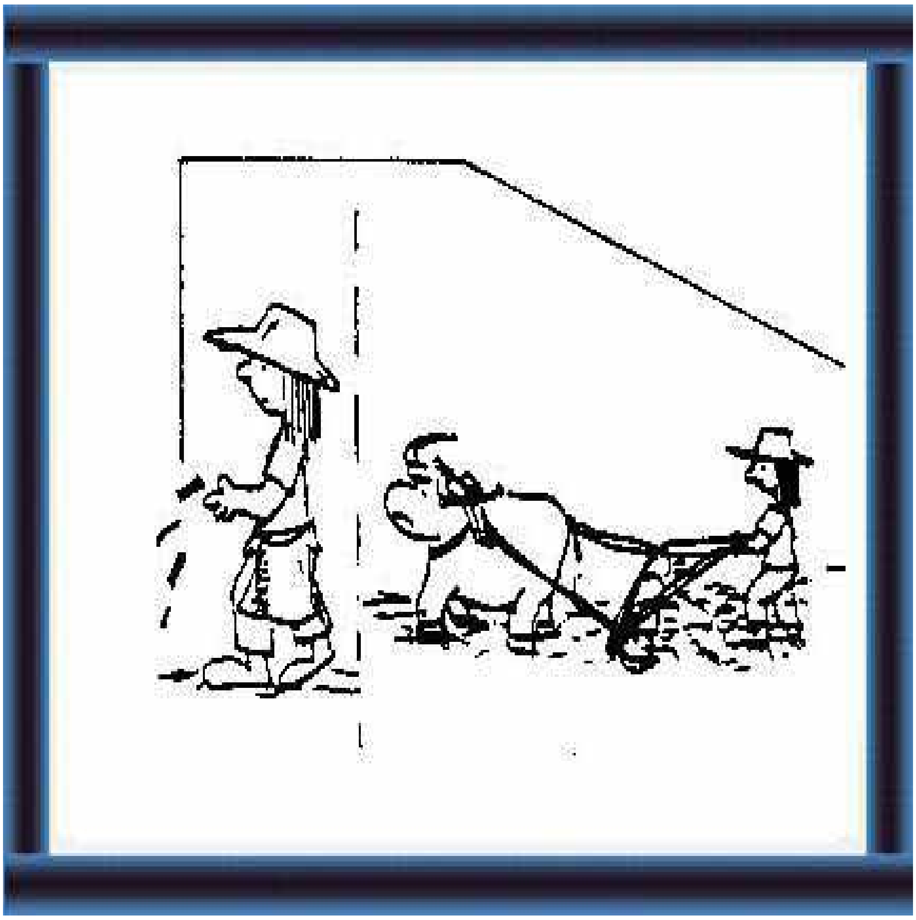
41
- plant in



furrows and cover by pushing the soil by foot.

42 **Rhizome or stolon** pieces e.g. Brachiaria species:
- spread on a loose seedbed
- push into the soil by foot or by driving a cart over them

or



43 in **wet** conditions:
- spread mature cuttings on a seedbed
- run a disc harrow over them

- to plant with a hoe or to drop into shallow furrows (44)

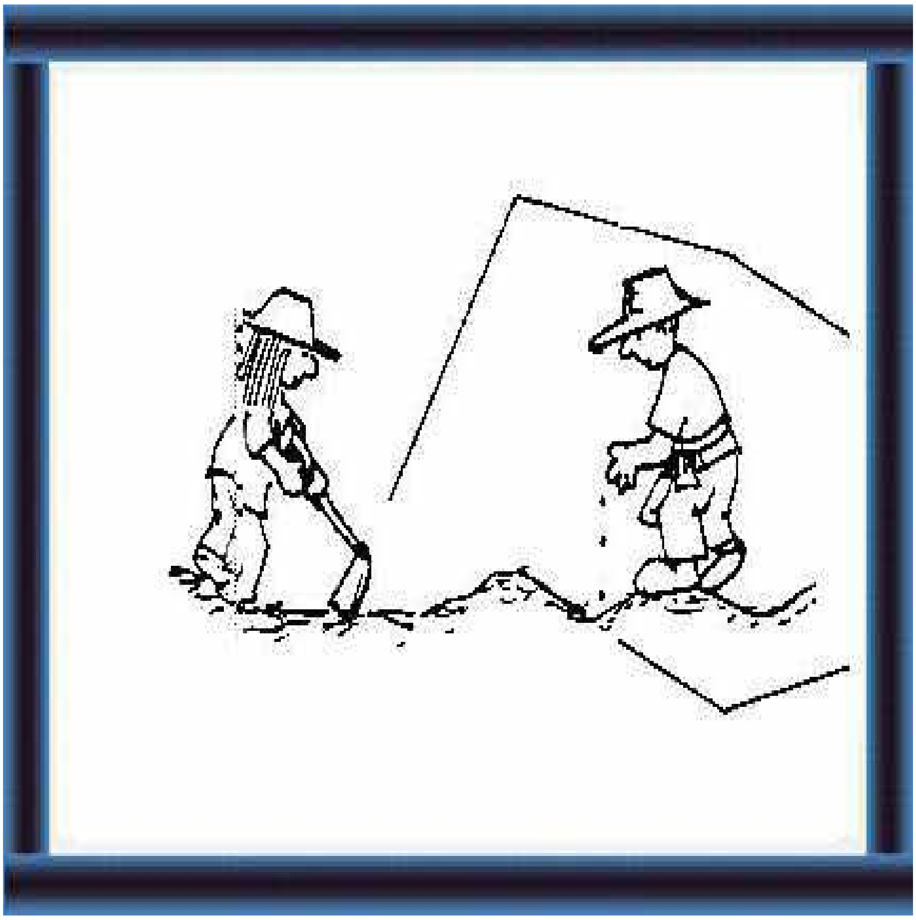
- and cover by turning soil with the plough or by pushing soil with the foot (under drier conditions - anticipating rain). (45)

Time of planting

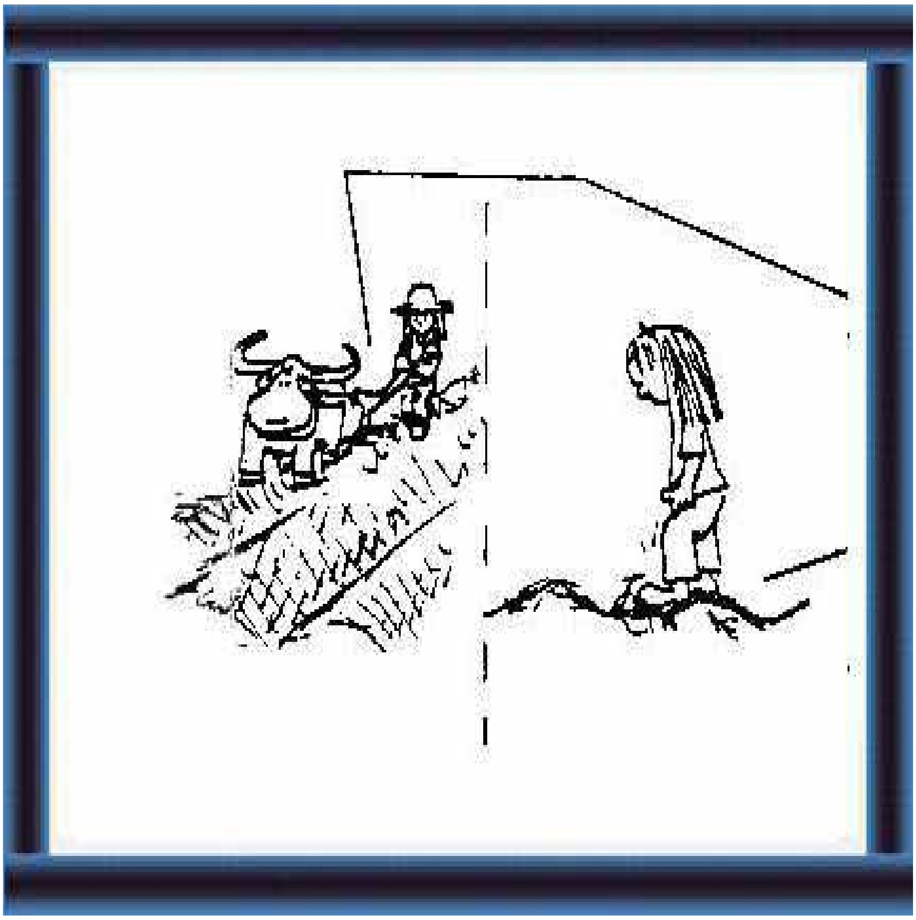
After land preparation, planting should be undertaken without delay to minimize the growth of weeds. Therefore, land preparation should take place with the first rains.

At the time of planting, the soil should be moist and additional rainfall should be available for a number of weeks after plant-ing. If irrigation facilities are available, timing of planting would not be constrained by rainfall. (46)

An adequate supply of appropriate planting material of good quality should be ensured at the time of land preparation. (47)



44 in **drier** conditions when you **expect rain**:
- plant with a hoe or drop into shallows furrows



45
- turn soil with a plough or push with foot.

Time of planting

46 Time land preparation with the **first rains** so that soil is **moist** and there is **rain after planting** (unless you have irrigation).

47 **Make sure** you have enough good quality planting material at the time of planting.

Fertilizer application

When the soils are too acidic, it is customary to add Lime or Dolomite to bring the soil pH to the desired levels, before planting the pastures/fodders/legumes. (48)

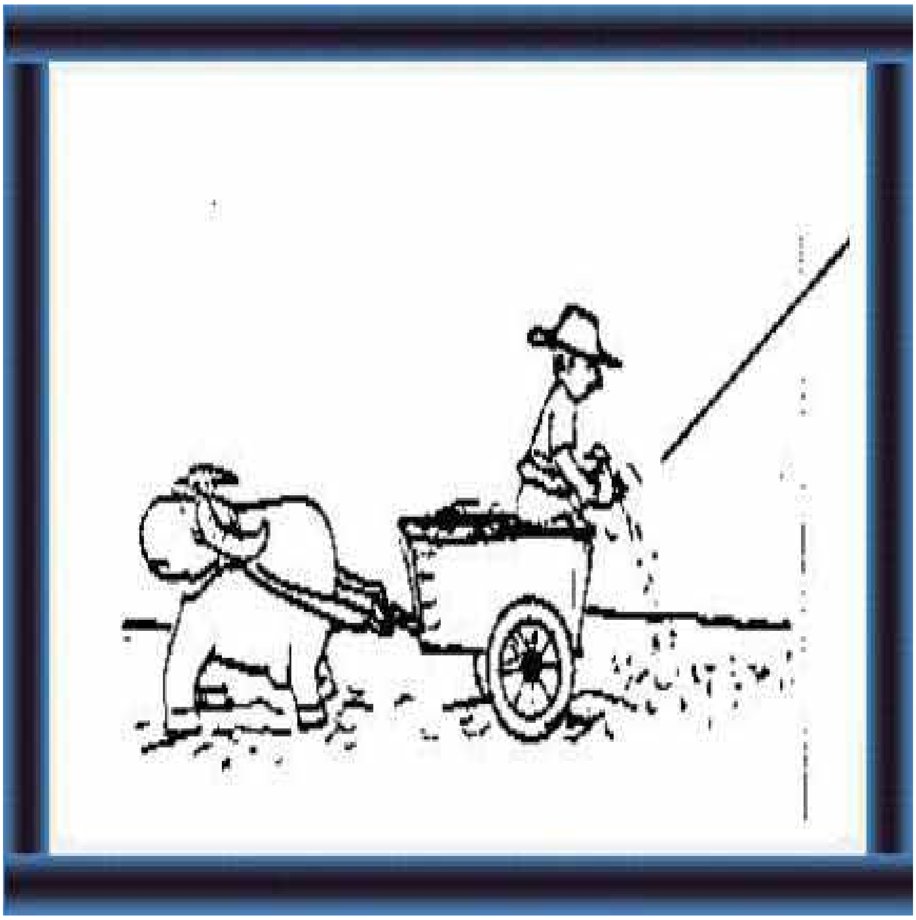
Three primary nutrient elements required by plants are Nitrogen, Phosphorus and Potassium.

- Small amounts of Nitrogen, usually applied in the form of Ammonium Sulphate or Urea will help the initial establishment and growth of newly sown or planted grasses. (49)

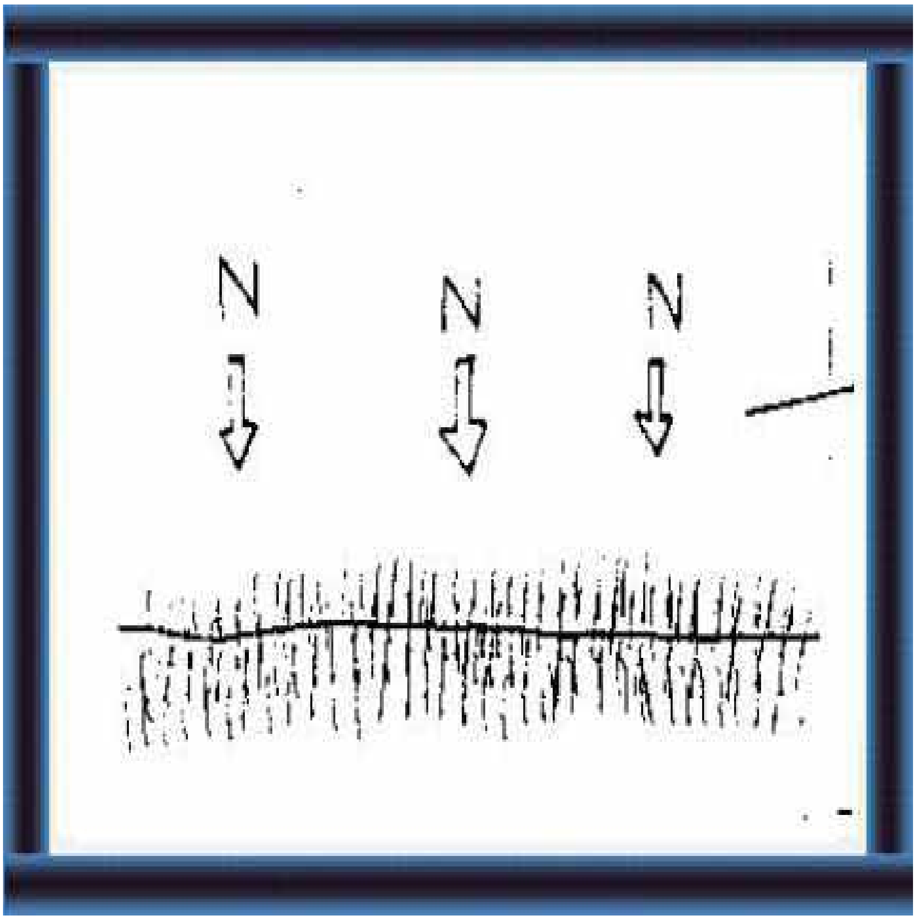
- Application of Phosphorus (usually in the form of Superphosphate) will benefit specially the legumes planted as pure stands or as mixtures with grasses. (50)

- Potassium is also needed especially by legumes for proper establishment. This is usually supplied in the form of Potassium Chloride. (51)

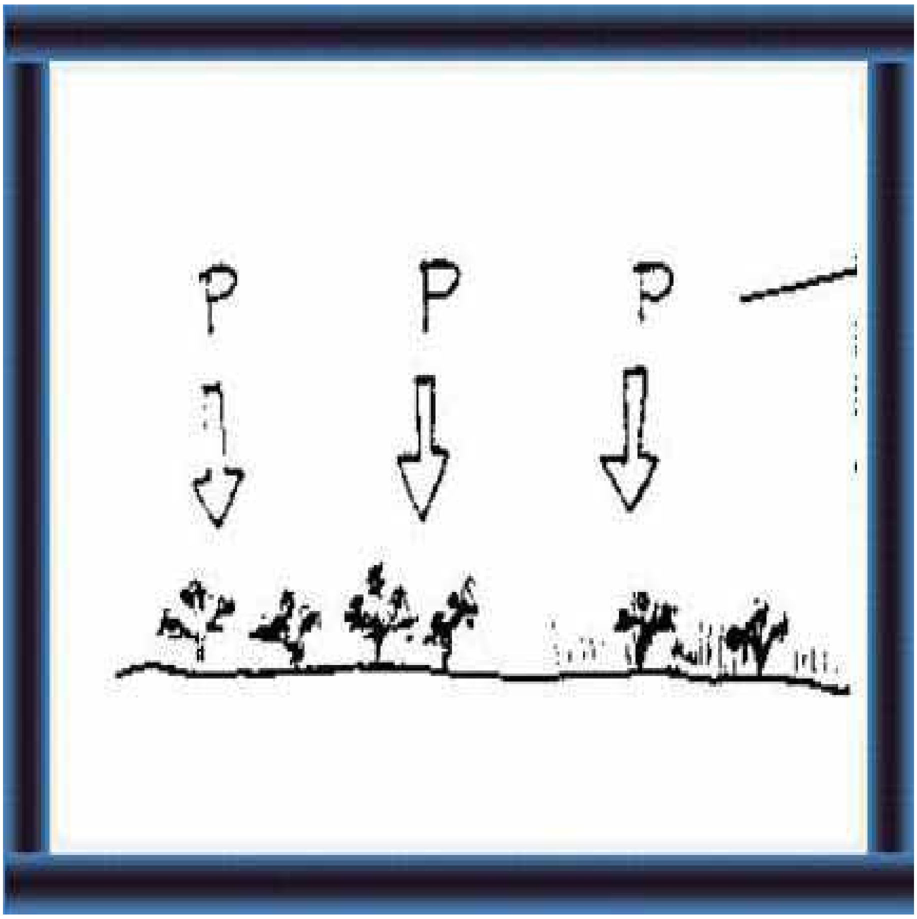
Fertilizer application



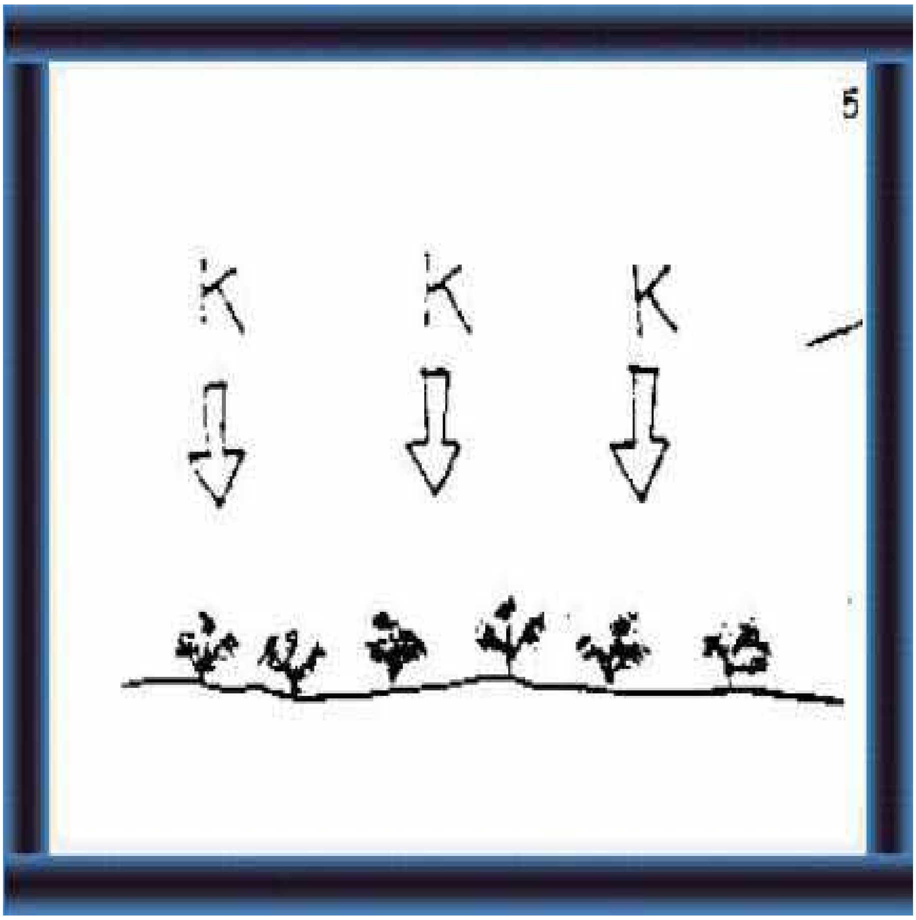
48 If your soil is **too acid** apply **Lime** or **Dolomite** **before planting** pastures/ fodders/ legumes to bring soil to the correct pH.



49 Plants need **3 major nutrients**. Give **Nitrogen** by applying e.g. Ammonium Sulphate or Urea. This helps **establishment** and **growth of grasses**.



50 Give **Phosphorus** by applying e.g. Superphosphate. This **helps** especially **legumes** planted alone or with grasses.



51 Give **Potassium** by applying e.g. Potassium Chloride. This **helps** especially **establishment of legumes**.

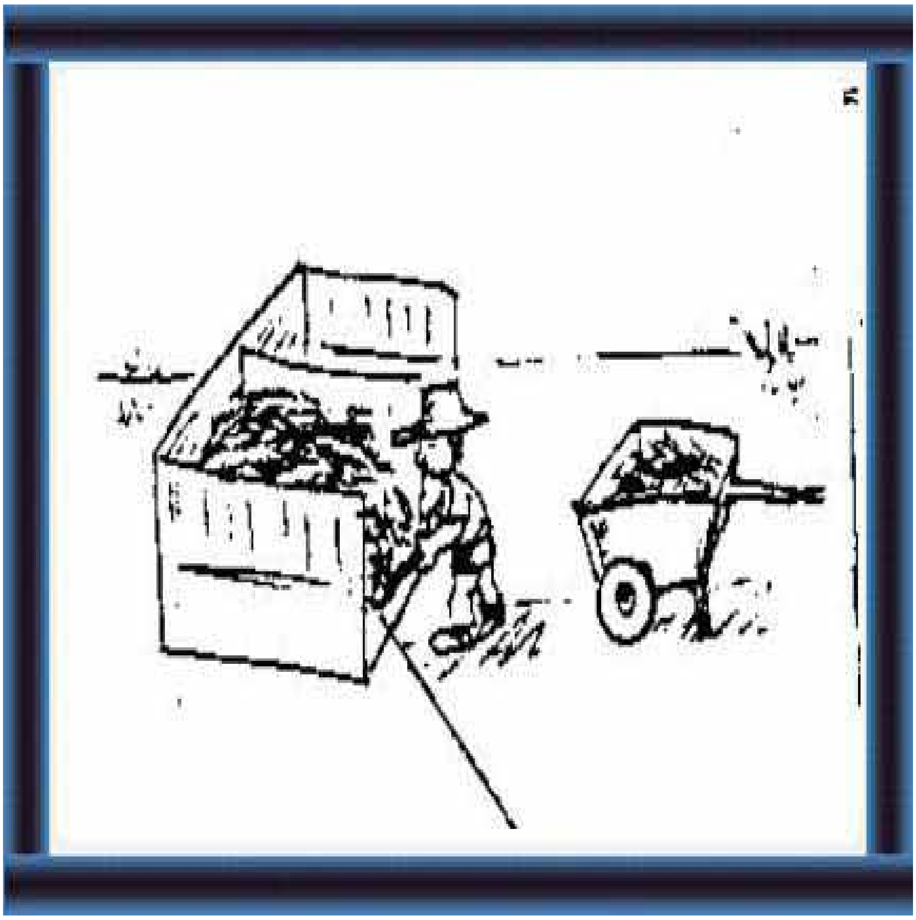
These nutrients can also be supplied by adding compost manure which will in addition improve the soil texture (see Unit H.1.2). (52)

The quantities of fertilizers to be added and the timing of application will depend on the rainfall, soil fertility and the varieties of pastures, fodders and legumes. The recommendations made by research institutions and extension officers should be followed in this regard. (53)

Grazing/cutting of newly planted pastures/ fodders

The varieties propagated by vegetative methods can be first utilized within 2-3 months, if adequate moisture (rainfall or irrigation) is available. (54)

Seeded varieties require a longer time to become established and may be first used in about 5-6 months time. (55)



52 You can add these nutrients by applying **compost manure** (See H 1.2).

53 **How much fertilizer** and

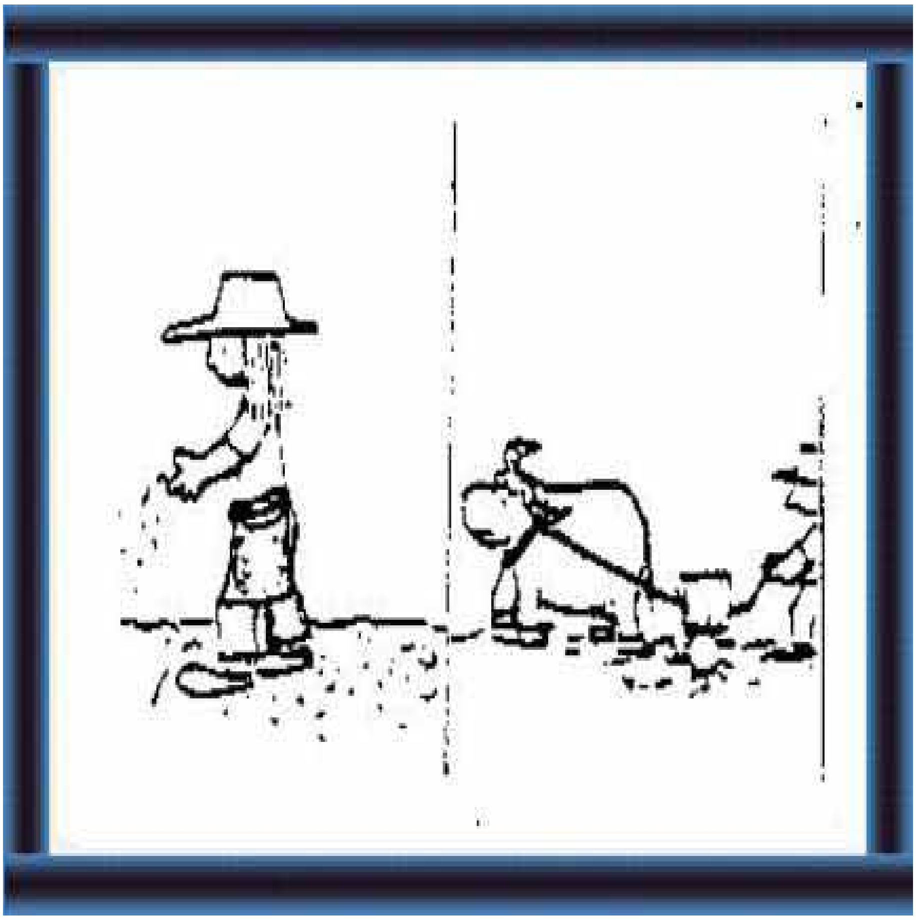
when you apply depend on:

- rainfall
- soil fertility
- type of pasture/ fodder.

Consult your extension worker.

Grazing/ cutting newly planted pasture/ fodder Vegetative propagation (See 38 above)

54 You can use within **2-3 months** if you have enough water (rainfall or irrigation).



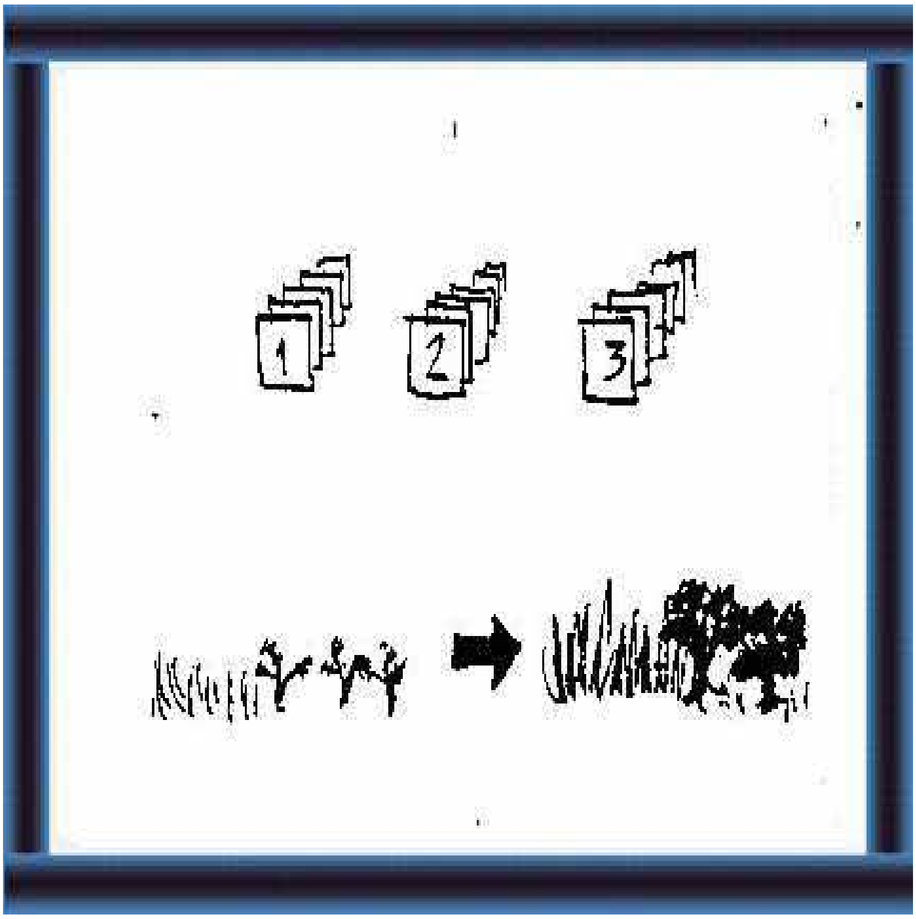
Seed propagation (See 36 above)
55
Establishment takes longer and you can use within **3-6 months**.

Subsequent management

The rate of growth of the pastures/fodders/legumes depend on the varieties used, rainfall (or irrigation), fertility of soil, cutting or grazing intervals etc. (56)

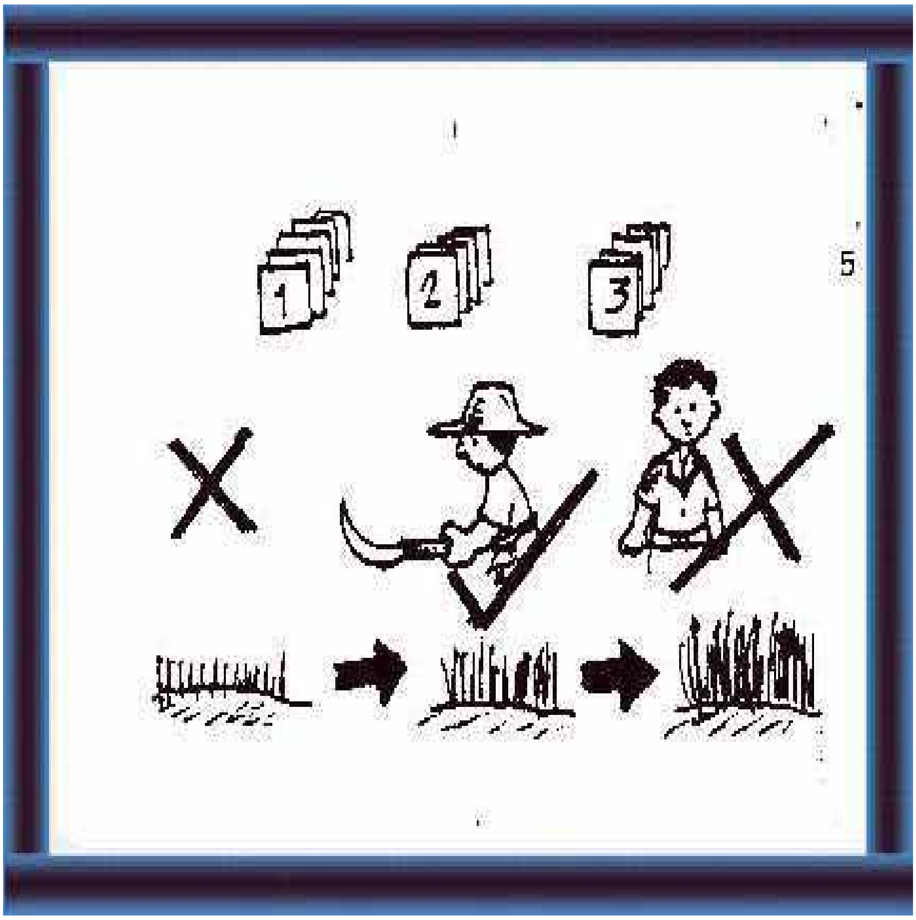
As the grasses mature, the dry matter yield increases but the overall digestibility and crude protein content decrease. Therefore, for animals to obtain the maximum amount of nutrients, the grasses have to be grazed or cut before they are too mature. Different varieties have different optimum grazing/cutting intervals. Advice should be obtained from research institutions and extension officers in this regard. (57)

Subsequent management



56 Growth of pastures/ fodders/ legumes depends on:
- variety
- rainfall or irrigation
- soil fertility
- cutting/ grazing interval etc.

57 Older grass has:
- more dry matter
- less digestibility



and crude protein content. Consult your extension worker about the best times to graze/cut.

Annex I: Improved varieties

Pasture (27)

Brachiaria brizantha (Signal grass)
Brachiaria decumbens
Brachiaria milliformis
Brachiaria mutica (Para grass, Water grass)
Brachiaria ruziziensis (Ruzi grass)
Cenchrus ciliaris (Buffel grass)
Cynodon species
Dactylis glomerata (cocksfoot)
Digitaria decubens (Pangola grass)
Panicum maximum (Guinea grass)
Panicum maximum (Hamil grass)
Paspalum plicatulum

Urvillei
Pennisetum clandestinum (Kikuya grass)
Setaria sphacelata
Tripsacum laxum (Gautamala grass) etc.

Legumes (30)

Centrosema pubescens
Desmodium intortum (Green leaf desmodium)
Desmodium uncinatum (Silver leaf desmodium)
Dolichos axillaris
Dolichos lab lab (lab lab bean)
Gliricidia maculata
Glicine javanica
Glicine wightii
Leucaena leucocephala (ipil-ipil)
Phaseolus atropurpureous(Siratro)
Pueraria phaseo-loides (Tropical Kudzu)
Stylosanthes guyanensis (Cook stylo)
Stylosanthes hamata
Stylosanthes humilis (Townsville lucerne)
Styzolobium atterimum (Velvet bean)
Trifolium pratense (Red clover)
Trifolium repens (White clover)
Trifolium rupellianum (African clover)
Trifolium semipilosum (Kenya white clover).

Fodders (31)

Some of the varieties listed under pastures and legumes can also be used as fodders, e.g.

Brachiaria ruziziensis
Panicum varieties
Paspulum varieties
Glyricidia
Leucaena etc.

Some varieties that are used mainly as fodders are:

Pennisetum purpureum (Napier grass or Elephant grass)

and its newly developed hybrids such as:

"NB 21" or "Poosa Giant Napier"
Fodder maize varieties
Newly developed hybrids
Fodder sorghum varieties
Newly developed hybrids etc.

What do you know about pastures and fodders?

Reasons for using high quality roughages or concentrates

Selection of suitable roughages

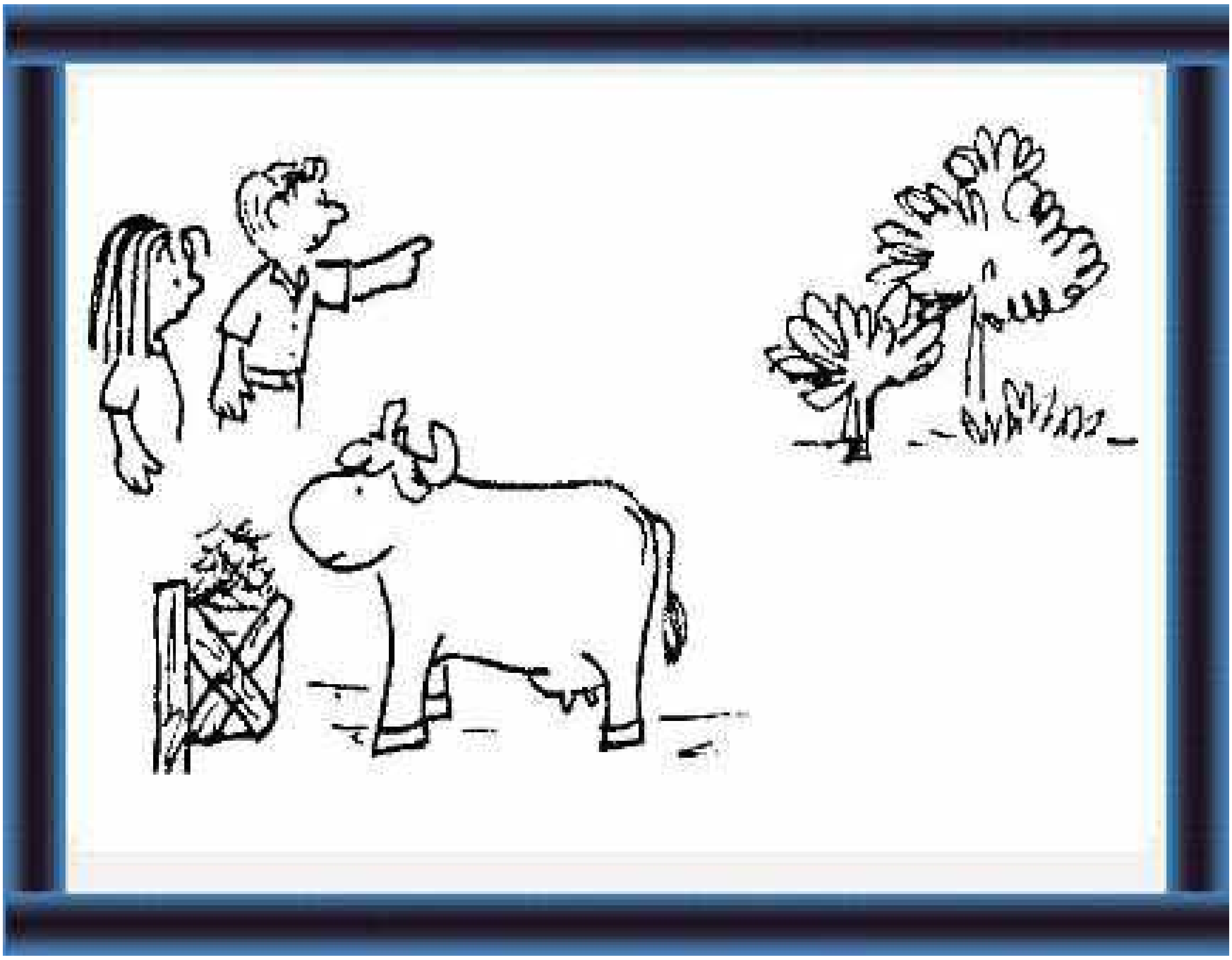
Small-Scale

Dairy Farming Manual

Volume 3

Husbandry Unit 5.2

FODDER FROM SHRUBS AND TREES



Extension Materials

What should you know about fodder from shrubs and trees?

What are the advantages of feeding shrub and tree fodders to your animals? (5-13)

1 They:
- provide feed for your animals
- save you work
- save you money.

Are there any disadvantages? (14-16)

2 You should not use more than 30 % of shrub and tree fodders in your feed.

What suitable varieties of shrubs and trees are there? (17)

3 See Annex I.

How can you establish and manage tree fodders? (18-40)

4 See the examples:
- Leucaena leucocephala (18-33)
- Glyricidia maculata. (34-40)

FODDER FROM SHRUBS AND TREES

Husbandry Unit 5.2:

Technical Notes

Note: Numbers in brackets refer to illustrations in the Extension Materials.

In Asian countries, fodders from trees and shrubs have been used for feeding livestock from ancient times. However, not much work has been done on their management and utilization for feeding dairy cattle and buffalo. With increasing interest in dairy development and competition for the limited land resources available, the potential of shrub and tree fodders in the feeding of dairy cattle and buffalo is being recognized.

The advantages of feeding shrub and tree fodders are many. Some of the important ones are:

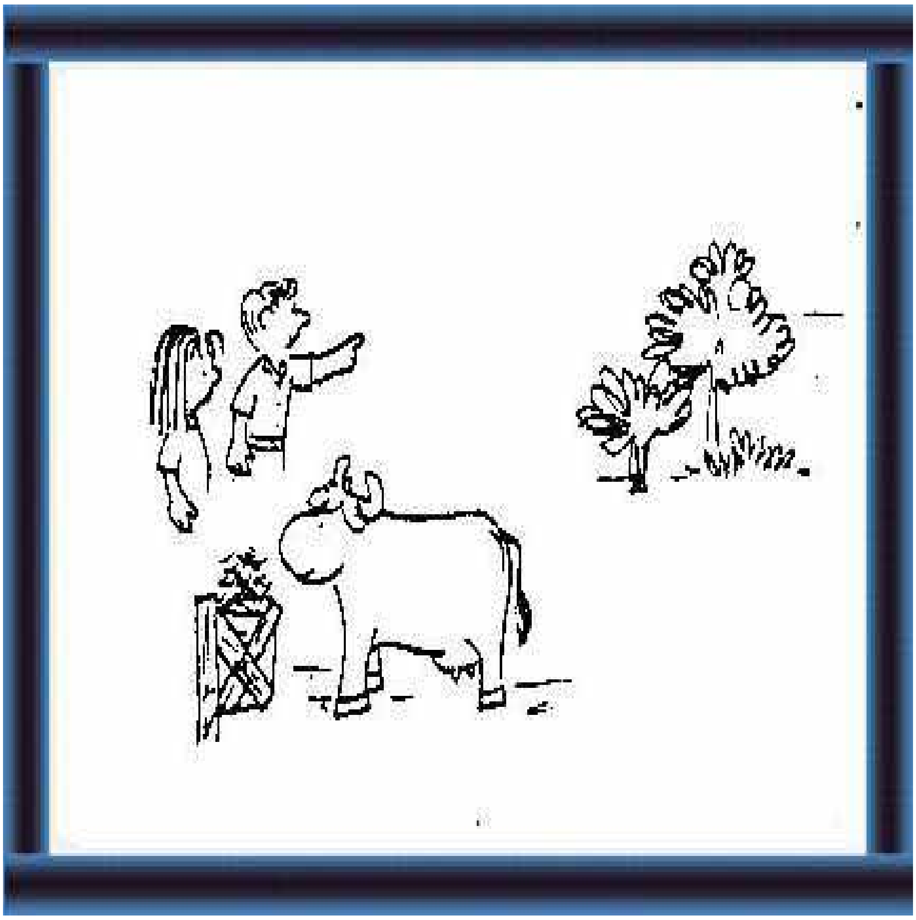
- there are some naturally growing shrubs and trees, fodders from which are already available for many farmers; an understanding of their nutritive value will enable them to be included in the diets of cattle and buffalo; (5)

- trees and shrubs can be grown on lands unsuitable for other crops and pastures; (6)

- they can be grown in crop areas, spacing them suitably to prevent excessive shade to the crops; (7)

- using them as fences and hedges reduces the costs of fencing which is an additional benefit; (8)

What are the advantages of feeding shrub and tree fodders to your animals?

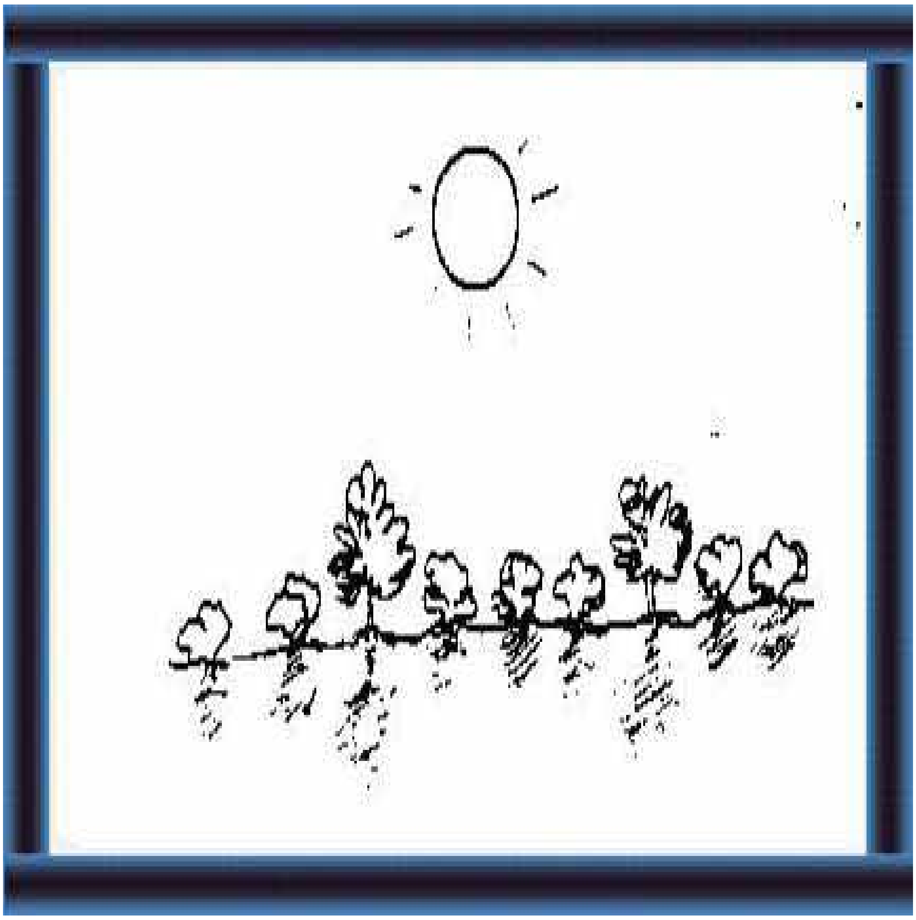


5 Some shrubs and trees grow naturally.

If you know their nutritive value, you can add them to your animals' feed.

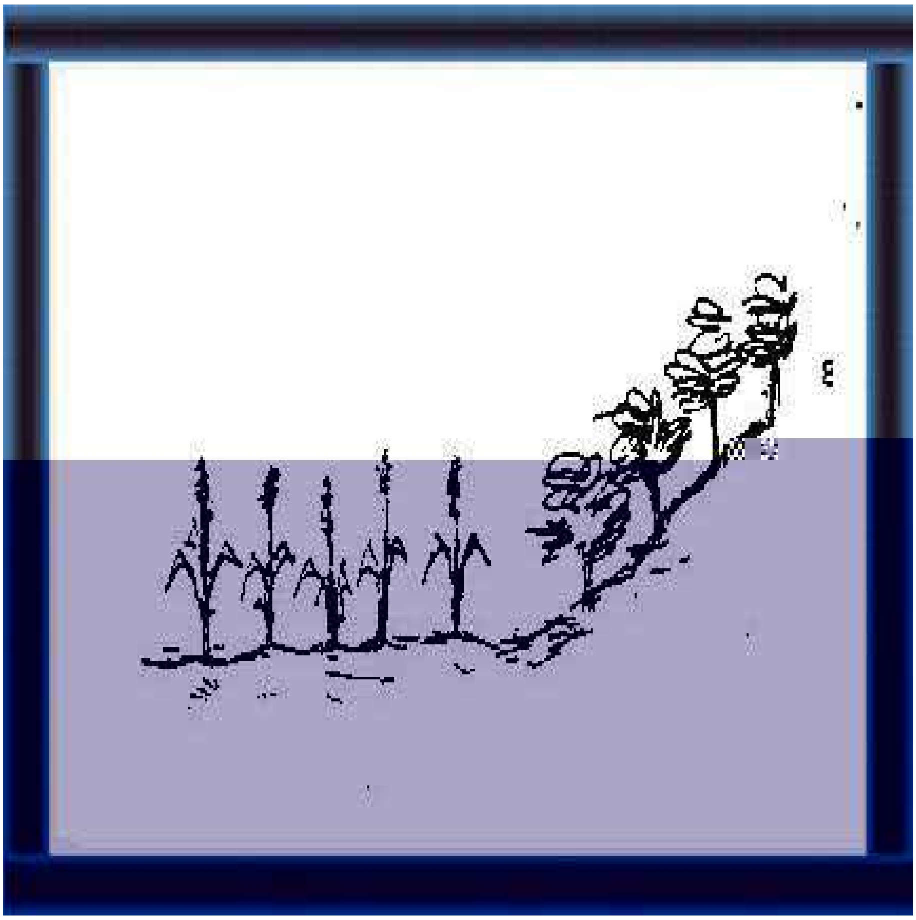
6 You can

grow shrubs and trees:
- on land which is not suitable for other crops and pastures



7
- with other crops.

Space them correctly so they do not shade other crops too much



8
- as hedges and fences.

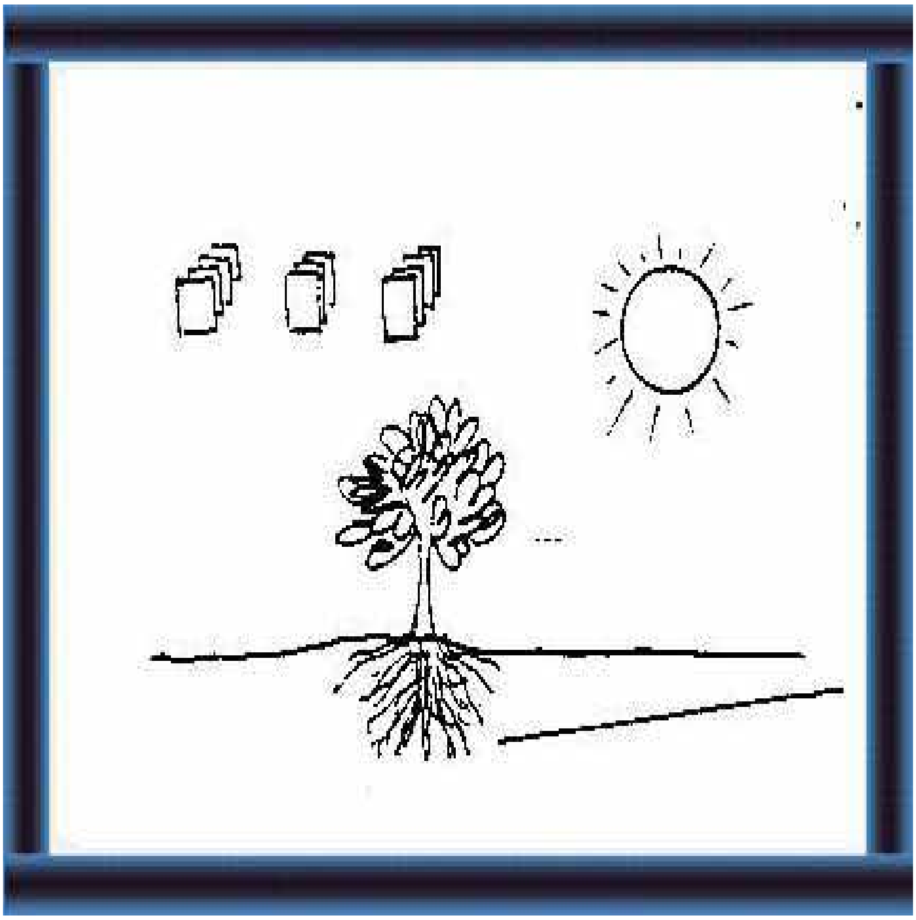
This saves you money.

- as the root systems penetrate deep into the soil, trees and shrubs can continue to produce foliage over a longer period into the dry season; (9)

thus cattle and buffalo can be given a green roughage along with crop residues such as straw, supplemented with concentrates where necessary, during the dry season; (10)

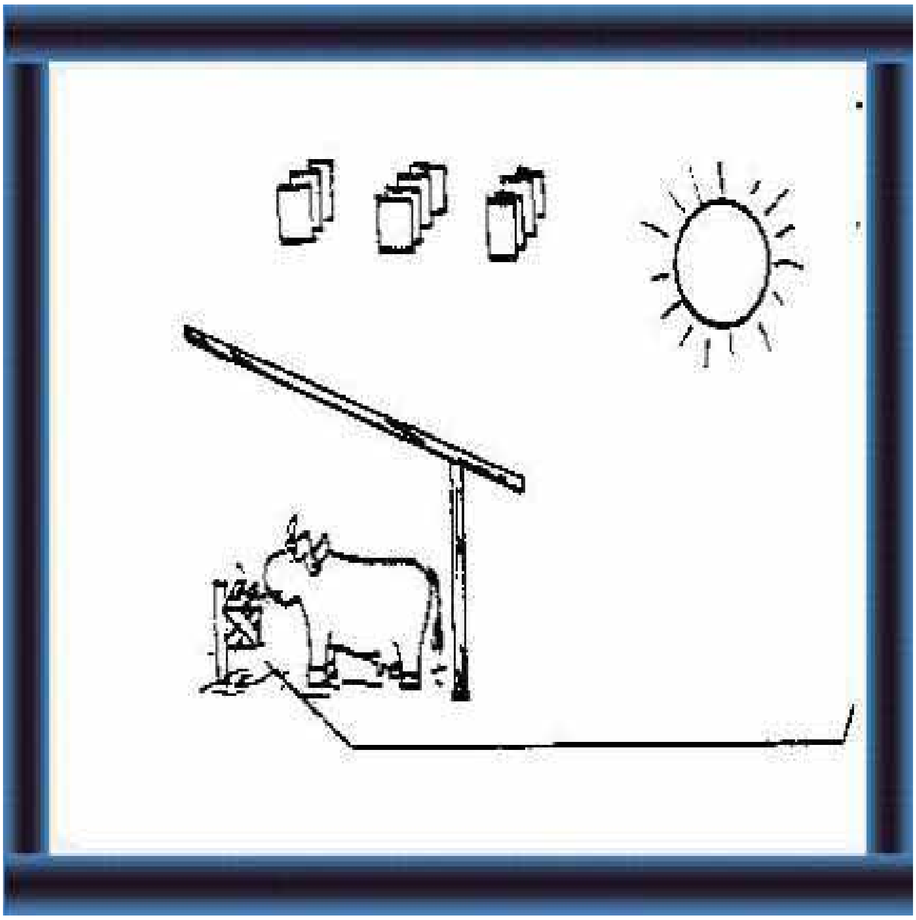
- establishment and maintenance are easier and less expensive than the pasture and fodder grasses and they have a long life span reducing the costs of re-establishment; (11)

- mature branches can be used as a source of firewood; (12)

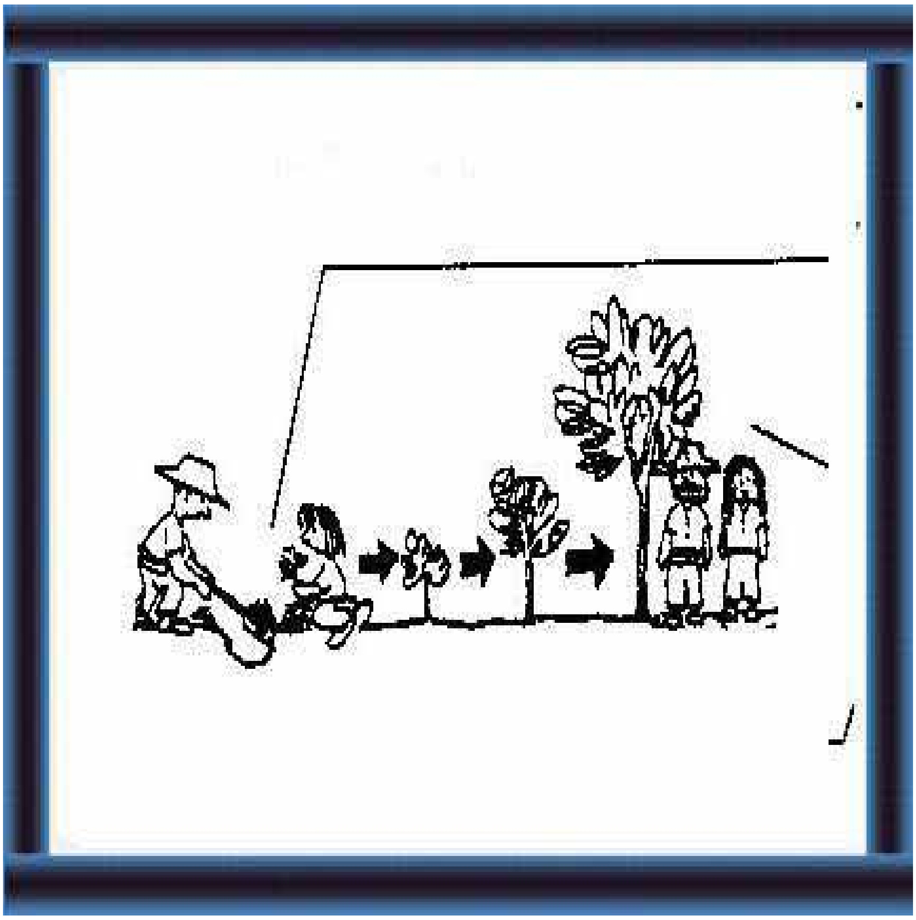


9 They produce foliage longer into the dry season because the roots go deep in the soil

10 so you can give your

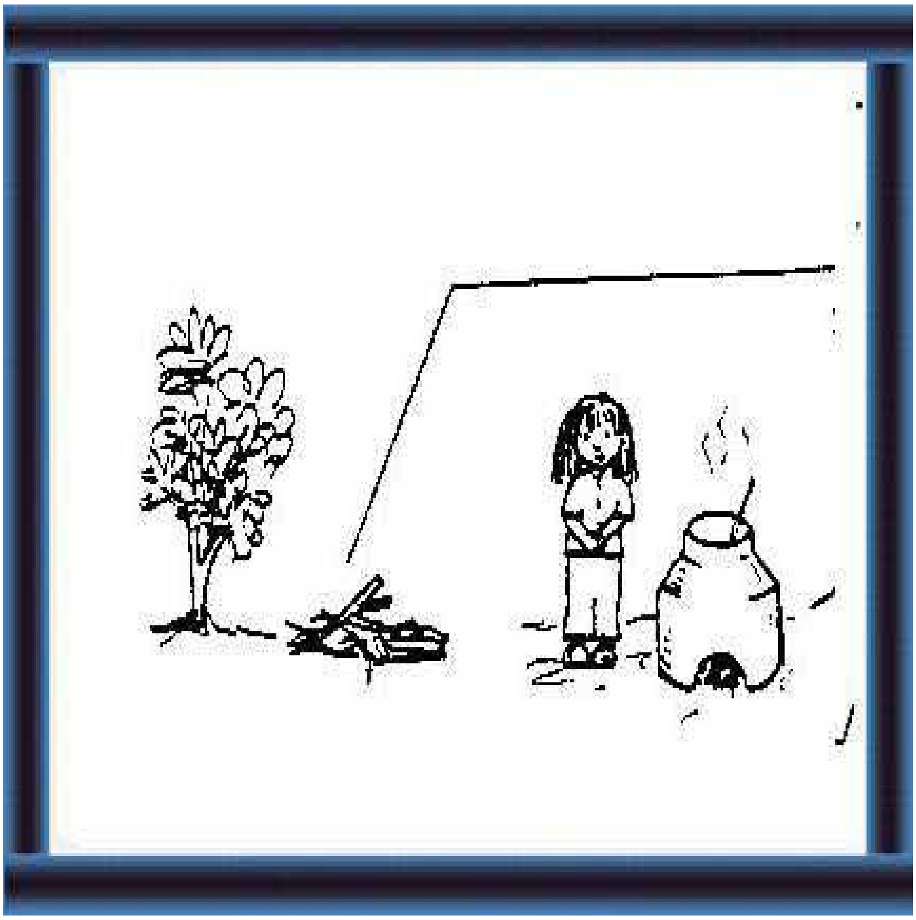


animals a green roughage with crop residues e.g. straw and concentrates (where necessary) in the dry season.



11 You can establish and maintain shrubs and trees more easily than pasture and fodder grasses.

They live a long time so you spend less money on re-establishment.



12 You can use mature branches

as firewood.

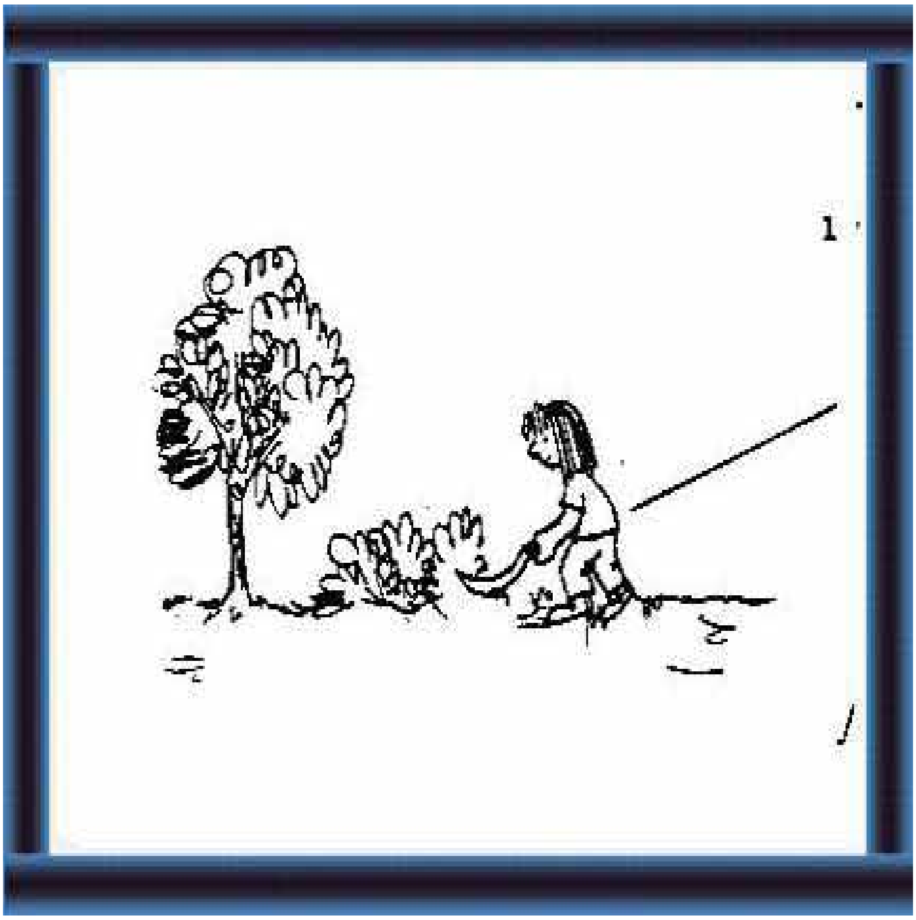
- when cutting is done manually, which is the practice with smallholders, it is more convenient and less time consuming with shrub and tree fodders than with many varieties of pasture and fodder grasses. (13)

The main disadvantage with tree fodders is that some of them have certain toxic compounds. However, these compounds usually occur only in small quantities and their ill-effects would disturb the animals only if they are given as the main (or only) feed over a long period of time. (14)

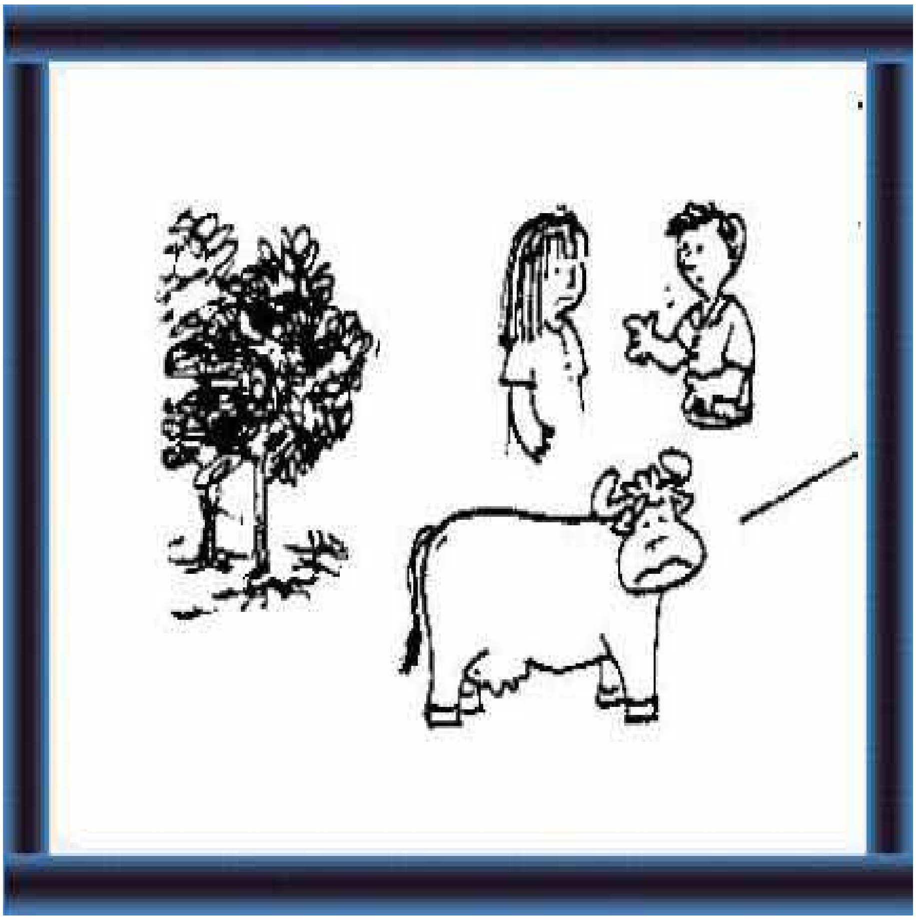
These ill-effects can be overcome by limiting the quantity of tree fodders to about 30% of the total daily feed intake (measured in terms of dry matter). (15)

Another disadvantage is that adequate information on the

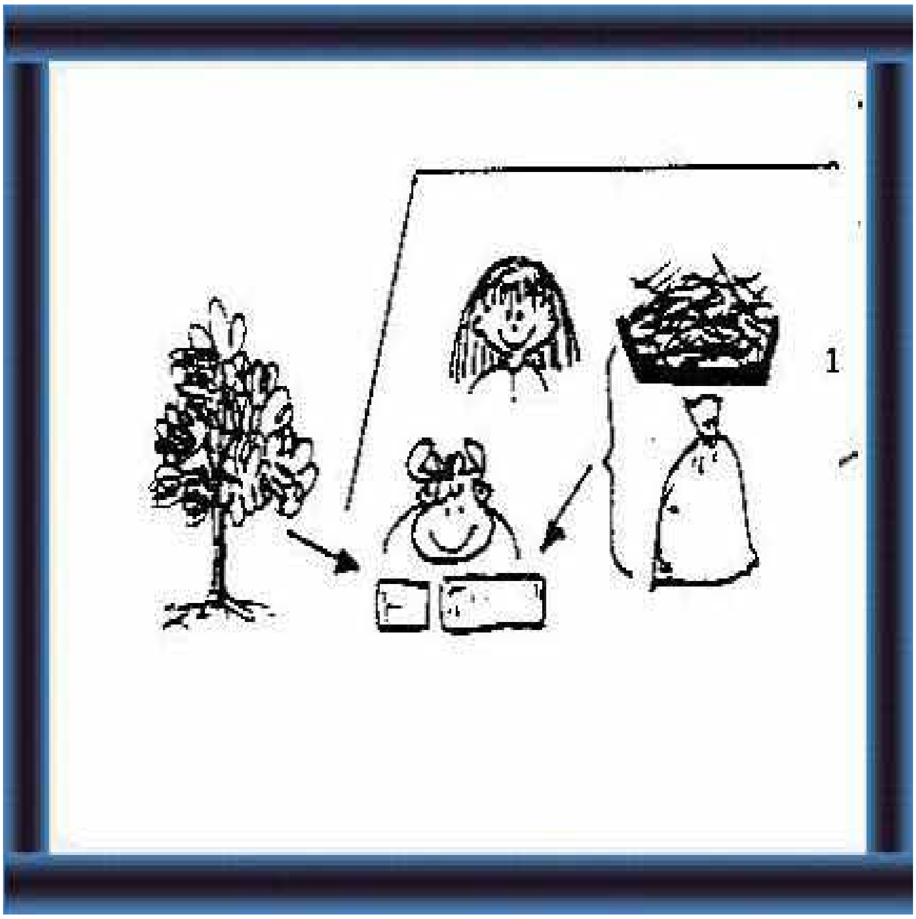
nutritive value of most of the tree and shrub fodders is not freely available. This is a problem that must receive the attention of research institutions and extension officers. Presently available information shows that fodders from such plants as Leucaena leucocephala (ipil ipil) and Glyricidia maculata are as nutritious or even more nutritious than some of the pasture and fodder grasses. (16)



13 It is easier and quicker to cut shrubs and trees/ fodders by hand than to cut pasture and fodder grasses.



Are there any disadvantages?
14 Tree fodders contain small amounts of poisons which are bad for your animals if tree fodders are the only feed for a long time.



15 Up to 30 % of tree fodder in feed (measured by dry matter) should cause no ill effects.

16 Ask your extension worker for information (though sometimes there is none for shrub and tree fodders).

Suitable varieties

There are several varieties of fodder trees and shrubs which can be grown under different agro-climatic conditions. They are classified in the Annex. (17)

Establishment and management of tree fodders

Tree and shrub fodders can be propagated vegetatively or by seeds depending on the species. Two examples are given below, one for propagation by seeds and the other by stems as well as seeds.

Example 1

Leucaena leucocephala: **There are many varieties of this species. Different varieties are being recommended in different countries. Even though many Leucaena plantations were destroyed by an insect during the mid 1980's, resistant varieties have now emerged. Leucaena does not grow well in water-logged areas and acidic soils. In acidic soils, acidity has to be reduced by the addition of Lime or Dolomite. Addition of Superphosphate will facilitate the initial establishment. (18)**

Propagation is by seeds.

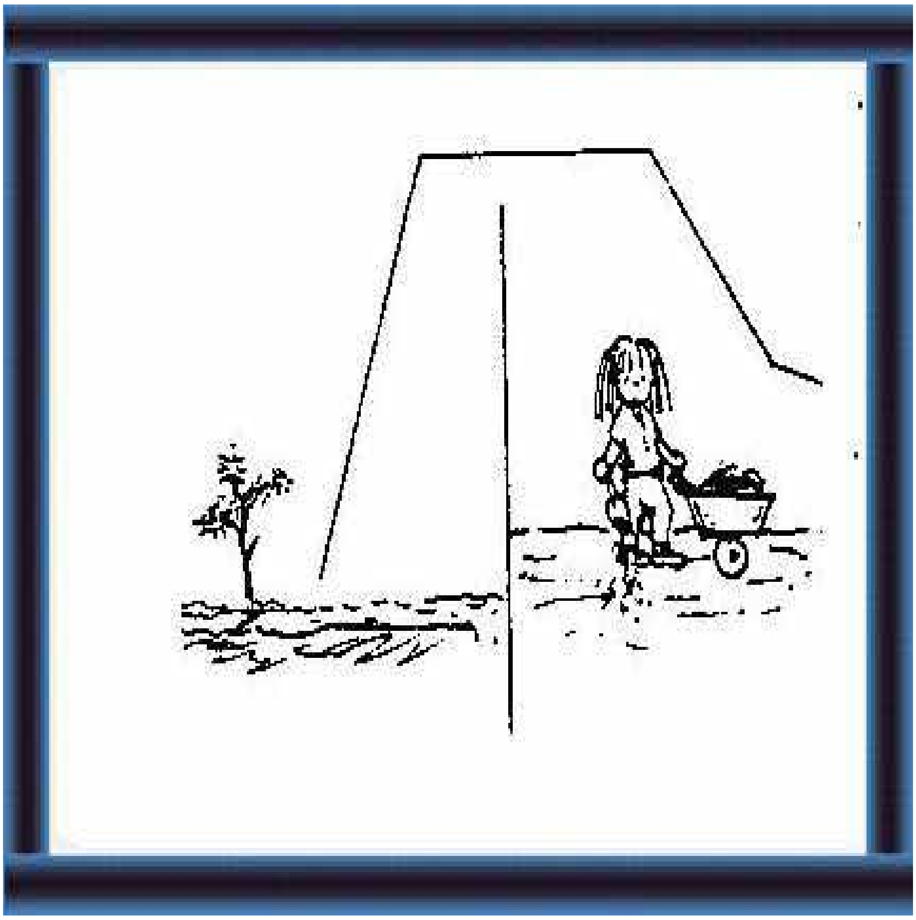
- Seeds have to be soaked in boiling water for about a minute before planting to damage the hard seed coat. (19)

- Seeds are allowed to cool and then mixed with inoculum. Inoculum can also be added to the seed bed in the form of a solution, after the seeds have started to germinate. (20,22)

What suitable
varieties of

shrubs and trees are there?

17 See the list in the Annex for different local conditions.



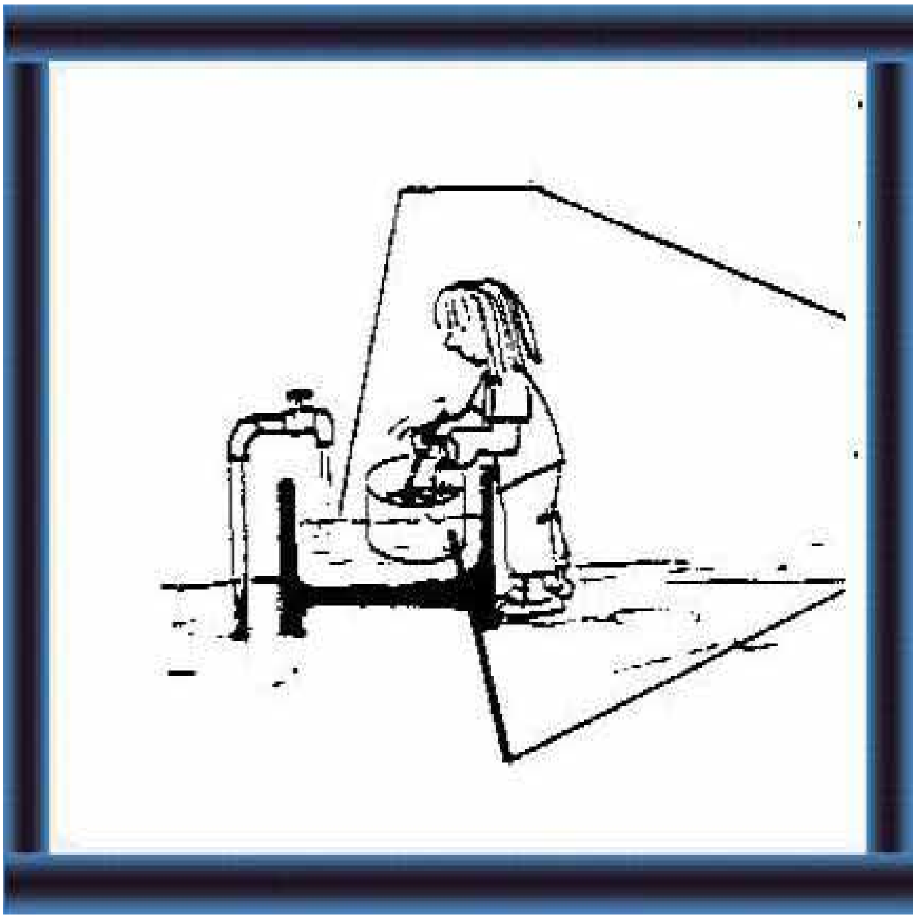
How can you establish and maintain tree fodders?

Leucaena leucocephala by seed propagation

18 Do not grow in water-logged soils.

Apply Lime or Dolomite to acid soils and Superphosphate to help establishment.

19 Soak the seeds in boiling water for 1 minute to damage the hard seed coat.



20 Cool the seeds and mix with inoculum.

page 99

- Seeds can be planted directly in the soil; to avoid being attacked by rabbits, monkeys etc. repellents such as diluted fresh animal urine may be poured on the plants. (21)

- Another method is to plant the seeds in a nursery: e.g. small polythene bags containing a mixture of soil and compost (with an extra amount of Superphosphate, where necessary). Plant two seeds in each bag. (23-24)

page 100

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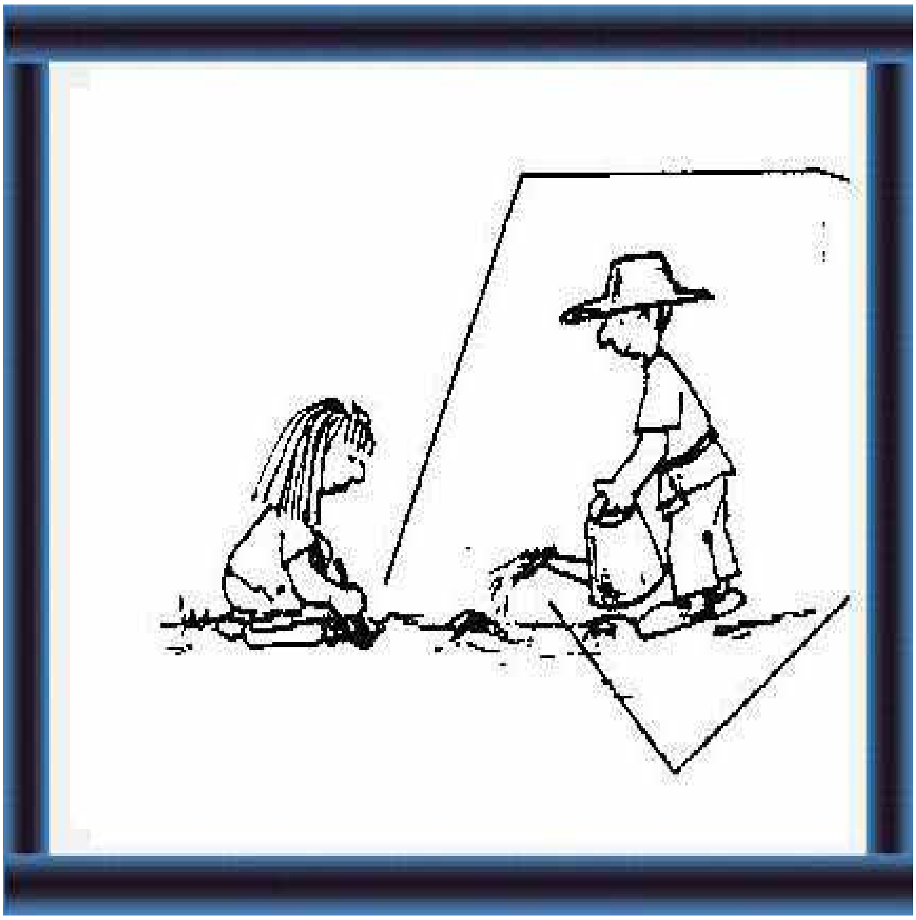
21 Plant the seeds directly in the soil.

Apply e.g. animal urine



mixed with water to keep rabbits, monkeys etc. away.

22 When the seeds begin to grow, you can apply a solution of inoculum.

23 You can plant the seeds in a nursery:
- mix soil with compost (and Superphosphate if necessary)

24
- fill small polythene bags with soil mixture

- plant 2 seeds in each bag.

- Transfer to the soil at planting time is easy but it is difficult to transport over long distances. (25)

- Another method is to add a layer of soil (and compost) about 15 cm thick over polythene spread on firm ground and to plant the seeds on this seed bed. (26)

- The seedlings are uprooted at planting time and all the leaves are pulled off by hand before transplanting in holes made with an iron bar. (27)

Space allowed between plants depends on where they are planted.

- If planted to serve as a fence, the spacing can be about 6 cm. Two or three rows planted at a distance of about 6 cm from each and maintaining the same space between plants makes a beautiful hedge. (28)

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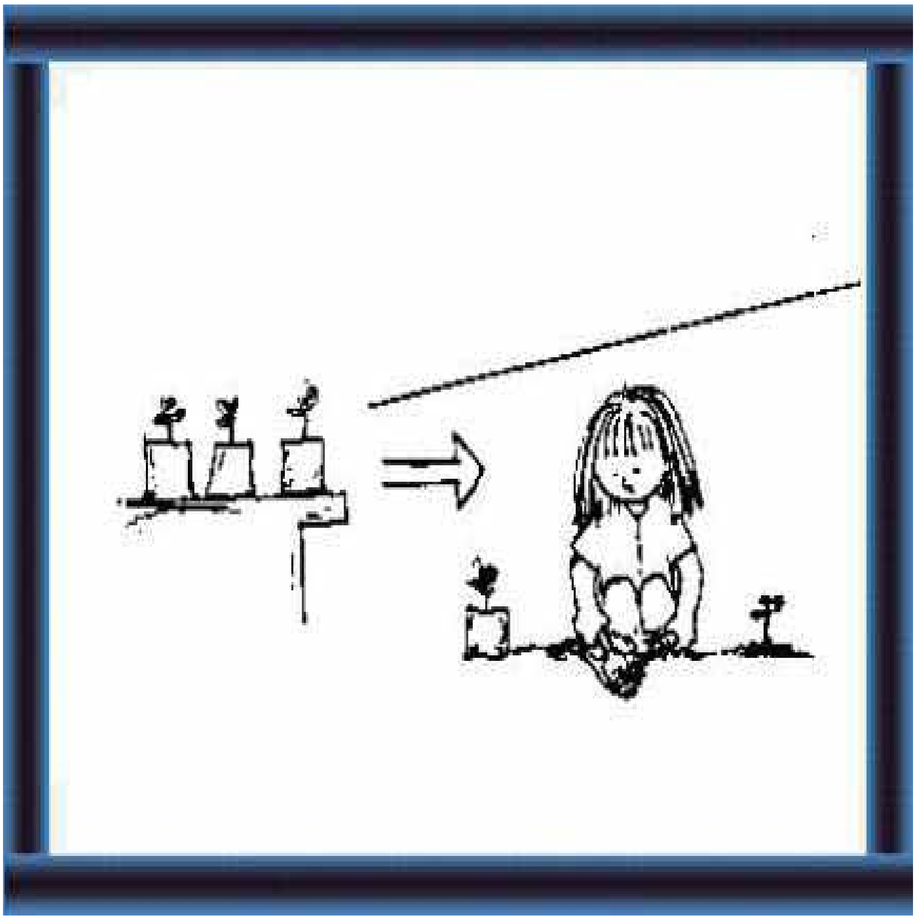
25 When the seedlings are 20-40 cm. tall, move



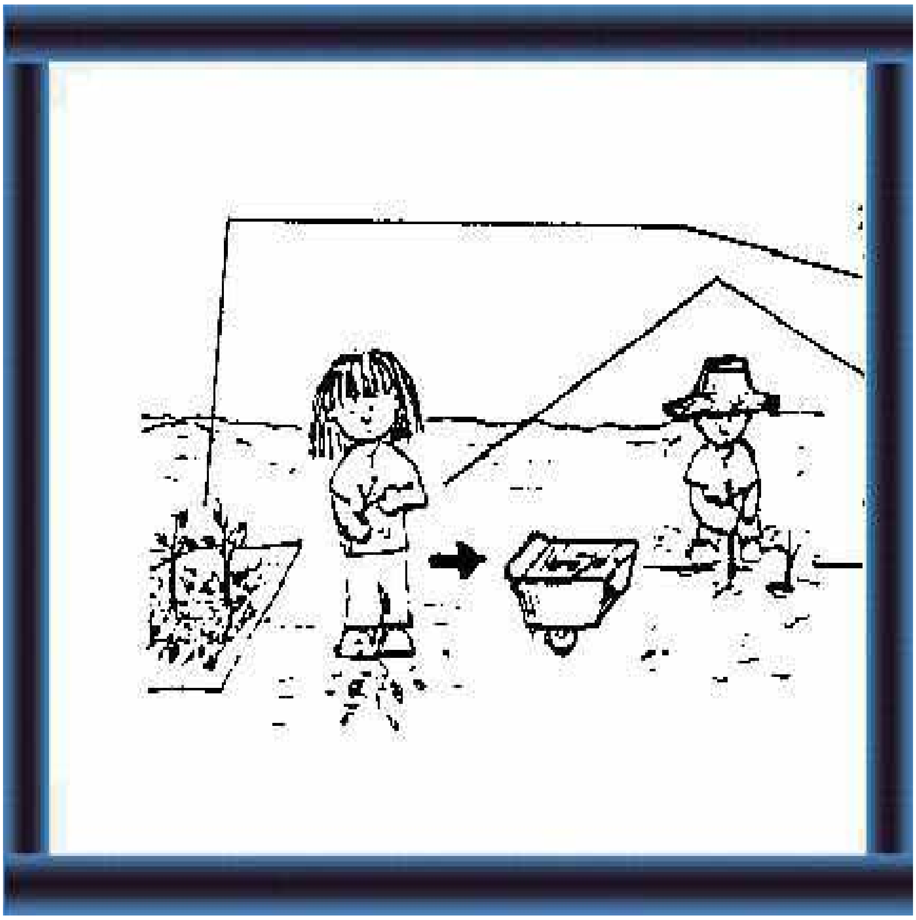
them to the field.

This method can be difficult if the field is far away.

26 You can also:
- spread a polythene sheet on firm ground

- add a 15 cm layer of soil/ compost

- plant the seeds on this seedbed



27
- uproot the seedlings at planting time

- pull all the leaves off by hand

- plant in the field in holes made with an iron bar.

28 For fences:
- plant 2 or 3 rows 6 cm apart

- each plant 6 cm apart in the row to make a beautiful hedge.

- Such hedges can be grown at a distance of 2-3 m on open pastures or as a component in an integrated farm-ing system. (29)

- They may also be grown as individual plants in an open pasture at spacings of 2 x 2 m; animals may be allowed to graze these plants with the pasture when they are about a metre high. (30)

- Alternatively, the plants may be allowed to grow to maturity beyond the reach of animals and the animals allowed to graze the new seedlings that sprout from the seeds falling onto the ground. (31)

- Leucaena plants can be grazed when they are about a metre tall. When they are cut to be used as a fodder, the plants may grow up to a height of about 1.5 to 2 m.

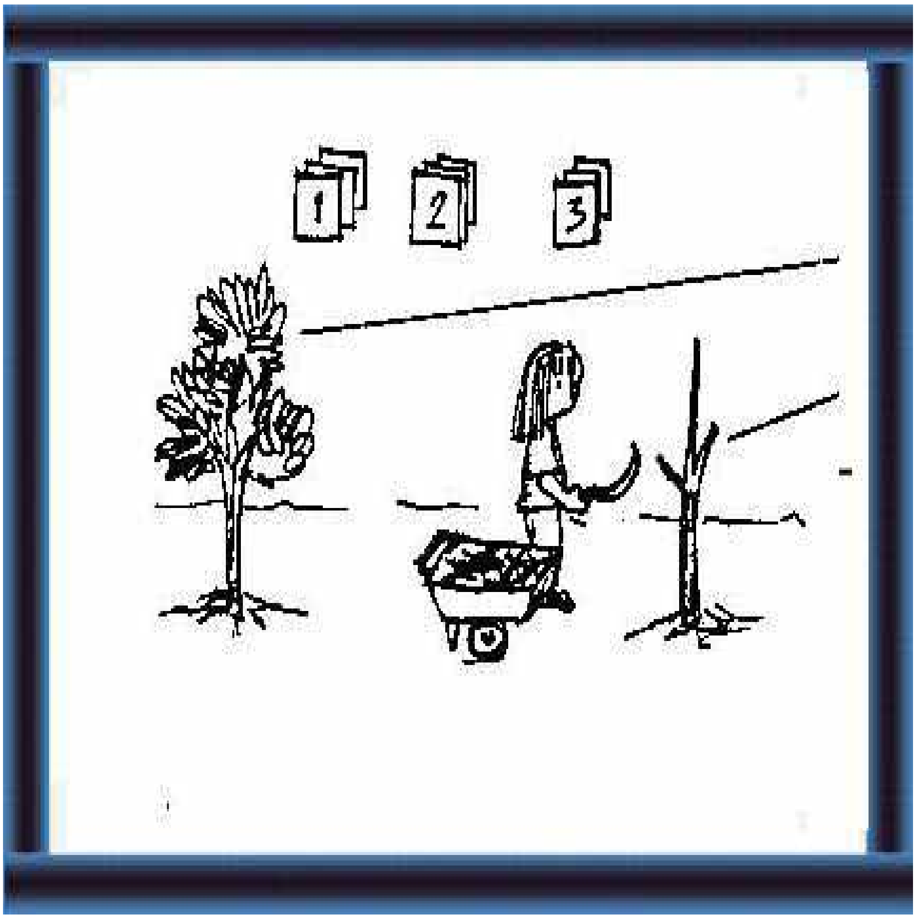
- Grazing or lopping is usually done at 2-3 month intervals. When lopping, it is good practice to leave a few small branches to facilitate regrowth. (32)

29 You can grow hedges at 2-3 m spacing on open pastures or as part of an integrated farming system.
(See H 1.1)

30 You can grow plants at 2 m spacing in open pasture.

Your animals can graze on the pasture and these plants when they are about 1 m high

31 or you can let the trees grow to full height and your animals can eat the seedlings from seeds on the ground.



32 Lop trees for fodder when they are about 1.5-2 m tall.

Leave a few branches for good regrowth.

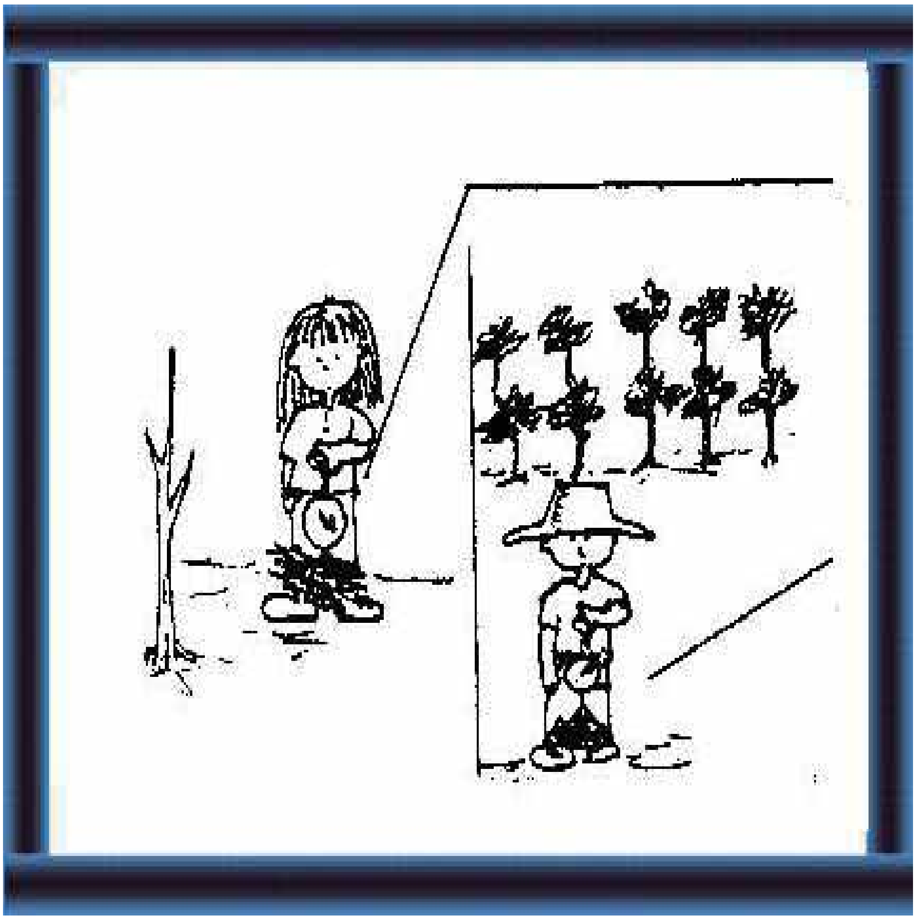
Graze or lop every 2-3 months.

- If adequate space is allowed between plants, e.g. when grown as separate plants or in a single row fence, each tree may give a yield of about 3-5 kg per lopping. The yield is lower during periods of drought. 90-100 trees will provide about 5 kg of leaves per day on average, throughout the year, if managed well. (33)

Example 2

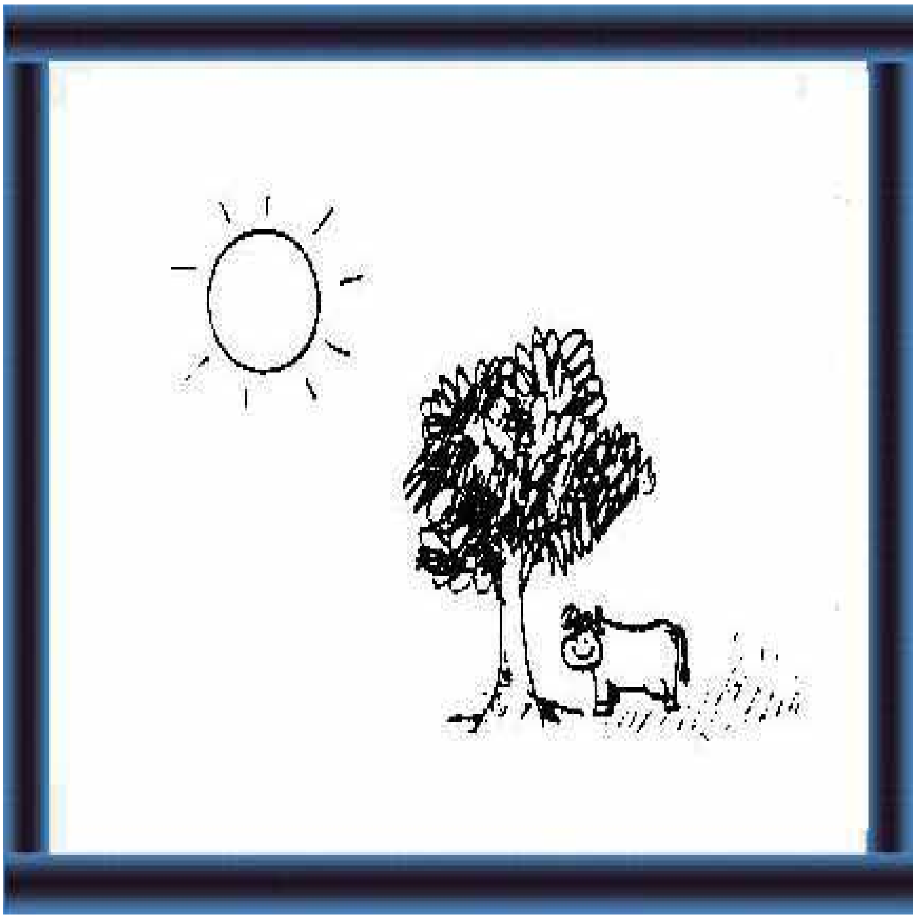
Glyricidia maculata: This species grows in a wide variety of agroclimatic regions and can thrive on many different types of soil. It has adapted well under adverse climatic conditions and shows a high degree of resistance to pests and diseases. Glyricidia is used as a shade tree in tea and coffee plantations and as a support and shade in pepper plantations. (34)

Propagation can be by seeds or stems. To prevent the planted stems being disturbed by cattle and buffalo, 1.5 m long stems can be planted along fences. The stems are planted in holes made by an iron bar. No other land preparation is usually necessary for planting stems. Spacing between plants varies depending on where they are planted: (35)
- in a single row fence, the spacing is usually 15-30 cm;
- in a double row fence, it is usually 60 cm between rows and 60 cm between plants;(36)



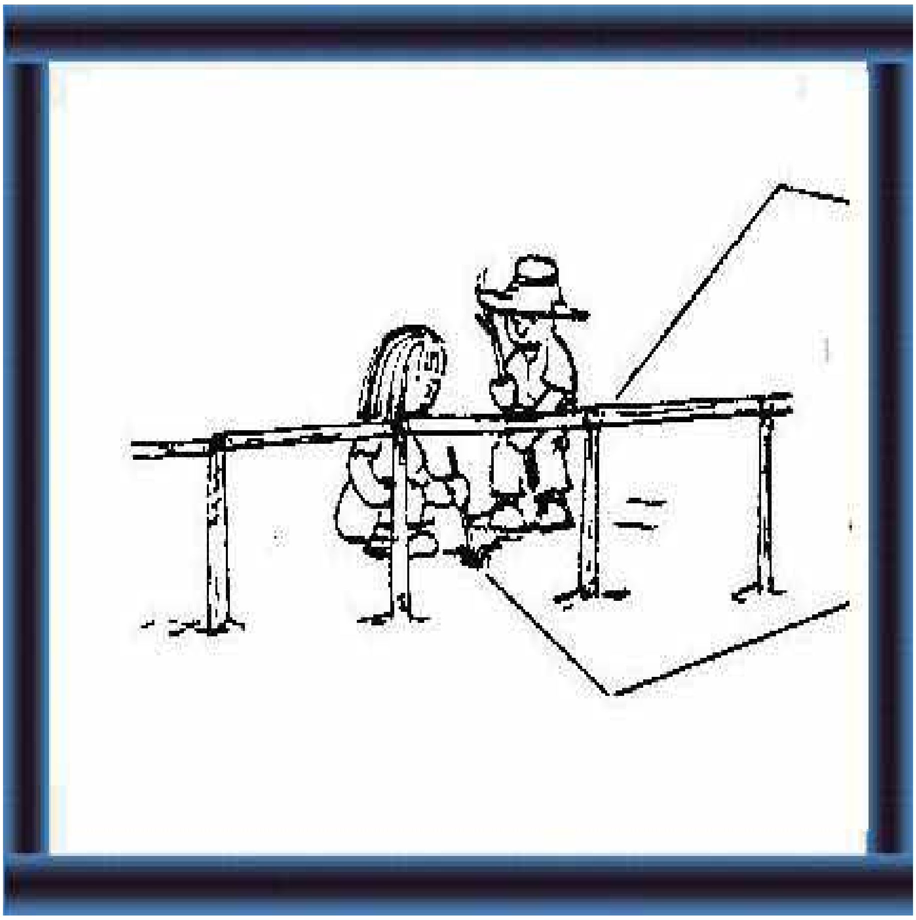
33 With enough space, each tree gives about 3-5 kg per lopping (less in dry periods).

90-100 well managed trees give about 5 kg leaves per day for the whole year.



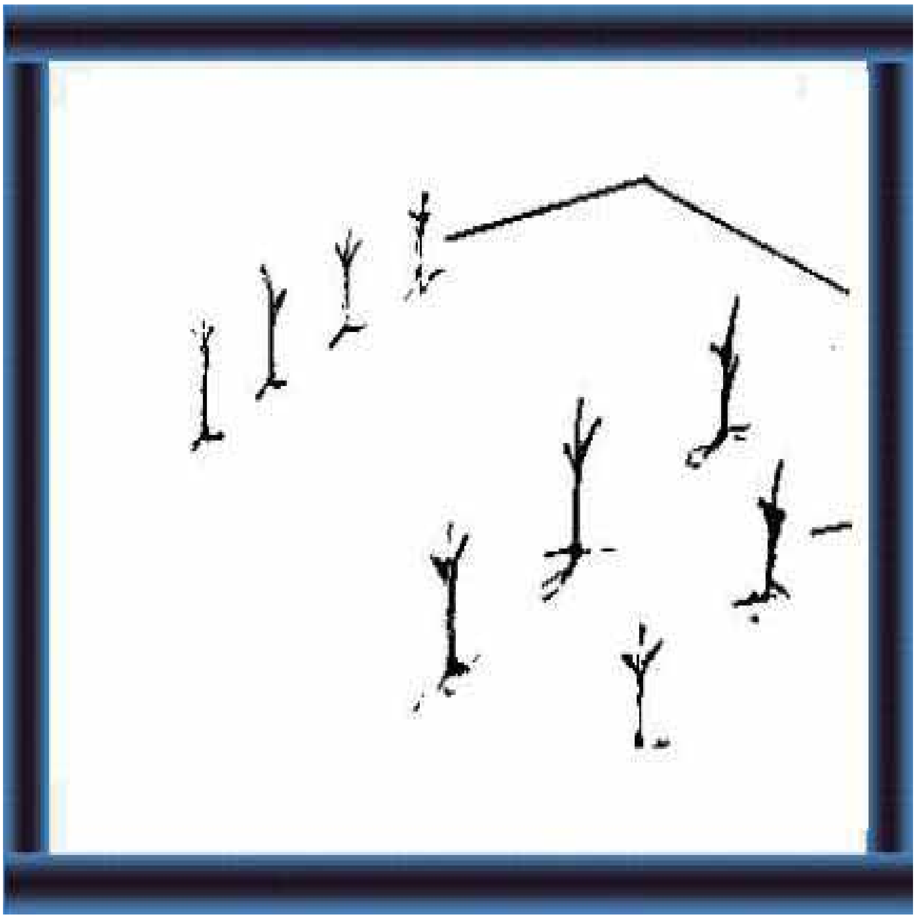
Glyricidia maculata by seed or stem propagation
34 This tree grows under many conditions and resists pests and diseases.

Farmers often use it for shade.



35 Plant 1.5 m stems along fences to protect from your animals.

Use an iron bar to make holes.



36 Spacing is usually:
- 15-30 cm in a single row fence

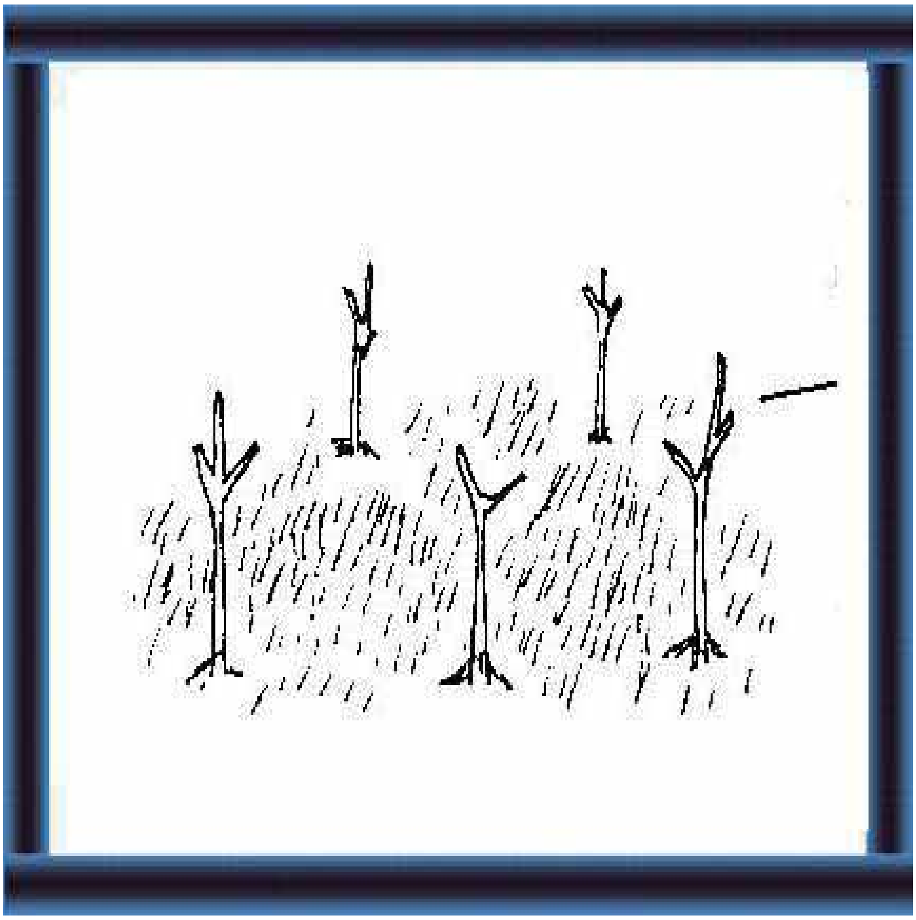
- 60 cm between plants and rows in a double row fence

- if planted individually among other crops, spacing is 5 x 5 metres. (37)

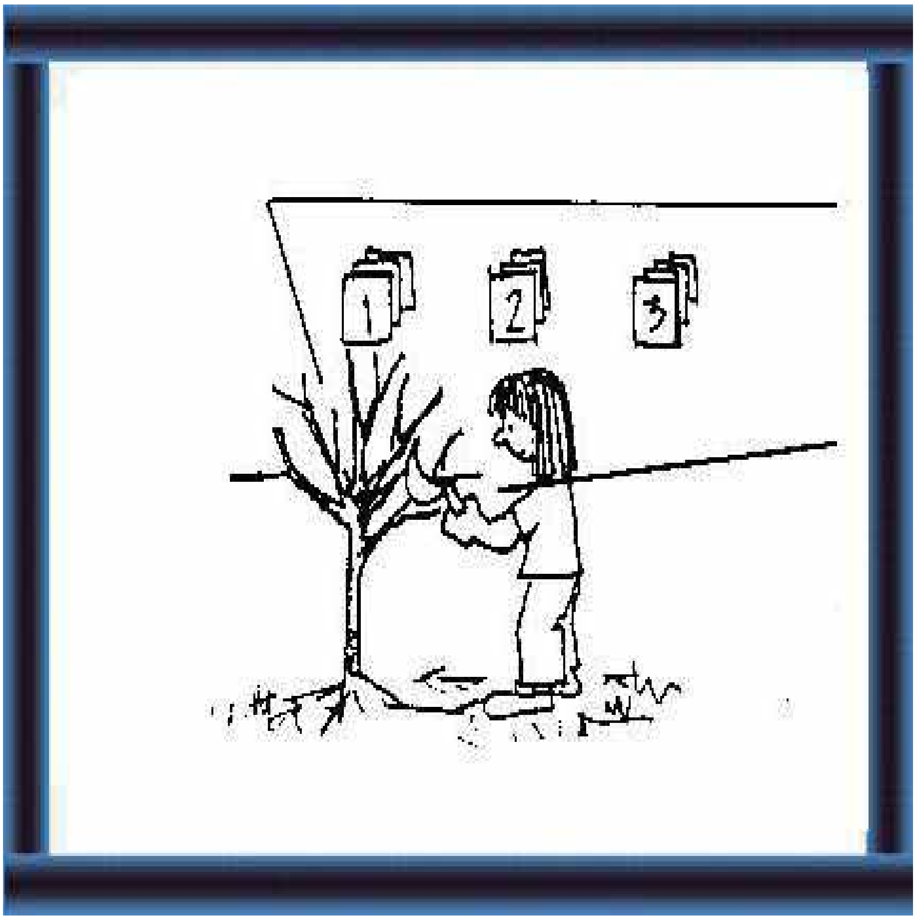
Lopping of branches is done once in about 2-3 months. The plants should not be allowed to grow to a height of more than 2.0 m. A single tree may bear about 10-15 branches at a time. (38)

When lopping, about 25 % of the branches are allowed to remain intact, to facilitate further growth. The harvest at one lopping is about 7-9 kg per tree. (39)

Addition of cow dung and compost increases the yield. It has been estimated that the yield from about 175-200 well managed trees would be sufficient to supply the roughage requirement of a cow throughout the year, when mixed with chopped rice straw. A fence of about 60 m length will have this number of trees. (40)

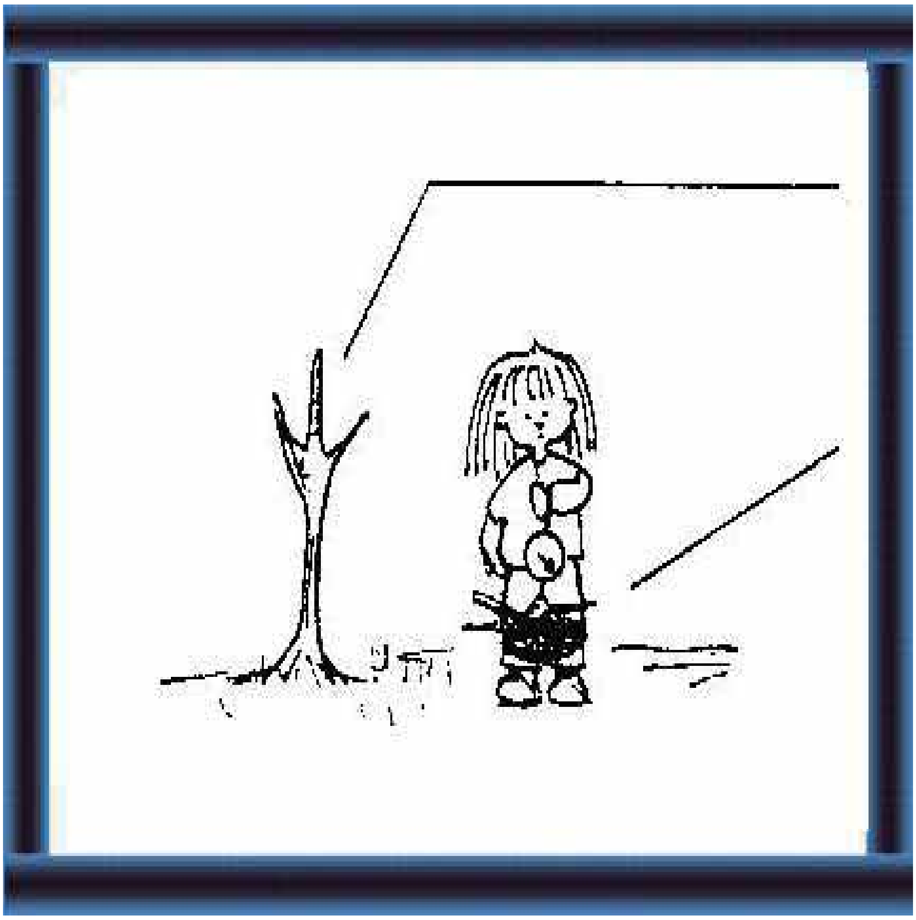


37
- 5 x 5 m for individual plants among other crops.



38 A tree can bear 10-15 branches at one time.

Lop every 2-3 months and do not allow to grow taller than 2.0 m.



39 Leave 25% of branches for good regrowth.

You should get 7-9 kg branches from each tree.

40 Apply cow dung and compost for higher yields.

175-200 well-managed trees (a fence of 60 m) gives enough roughage for 1 cow for 1 year when mixed with chopped rice straw.

Annex I

Species suitable for various climatic conditions

(a) Humid tropics

Albizia chinensis
A. lebbek
A. procera
Artocarpus heterophylla
Azadirachta indica
Bauhinia purpurea
Gliricidia maculata
Moringa oleifera
Morus alba
Leucaena leucocephala
Sesbania grandiflora
S. sesban.

(b) Semi-arid tropics

Acacia nilotica
A. tortilis
Ailanthus excelsa
Albizia amara
A. lebbek
Azardirachta indica
Capparis decidda
Dichrostachys cinerea
Hardwickia binata
Leucaena luecocephala
Parkinsonia aculeata
Pithecellobium dulce
Prosopis juliflora
Sesbania sesban
Tamarix spp.

(c) Arid tropics

Acacia nilotica
A. tortilis
Ailanthus excelsa
Albizia amara
A. lebbek
Bauhinia variegata
Casuarina equisetifolia
Dichrostachys cinerea
Hawdwickia binata
Zizyphus mauritiana.

(d) Temperate and sub-temperate areas

Betula alboides
Celtis australis
Morus serrata
Robinia pseudoacacia
Salix spp.

(e) Hot arid desert

Acacia arabica
A. tortilis
Albizia amara
Azadirachta indica
Dichrostachys cinerea
Eucalyptus terminalis
E. camaldulensis
Prosopis cinerea
P. juliflora.

(f) Semi-arid, rocky and gravelly

Acacia catechu
Ailanthus excelsa
Albizia lebbek
Cassia siamea
Dalbergia sisso
Dendrocalamus strictus

Dichrostachys cinerea
Hardwickia binata
Prosopis juliflora.

(g) Cold desert

Juniperus communis
J. wallichiana
Populus spp.
Salix spp.

(h) Ravines

Acacia arabica
A. catechu
A. tortilis
Albizia lebbek
A. amara
Dalbergia sisso
Dendrocalamus strictus
Dichrostachys cinerea
Eucalyptus spp.
Prosopis juliflora.

(i) Swampy and wet lands

Arundo danax
Baringtonia spp.
Bischoejia javonica
Eucalyptus robusta
E. rudis
Casuarina equisetifolia
Diosphyros ambryopteris
Pterospermum acerifolium
Sapium sebifecum.

(j) Shore and riverbeds

Acacia spp.
Albizia spp.
Dichrostachys cinerea
Hardwickia binata

Leucaena leucocephala
Sesbania spp.

(k) Cultivable wastelands

Acacia spp.
Albizia spp.
Dichrostachys cinerea
Hardwickia binata
Leucaena leucocephala
Sesbania spp.

(l) Saline-sodic soils

Acacia arabica
A. tortilis
Albizia amara
Butea monosperma
Dalbergia sisso
Prosopis juliflora
Salvadora spp.
Tamarindus indica.

Source: Singh, 1988

What do you know about fodder from shrubs and trees?

Advantages of feeding shrub and tree fodders

1 Growth and nutritive value (5-10)

2 Ease of establishment, maintenance and cutting (11-13)

Disadvantages

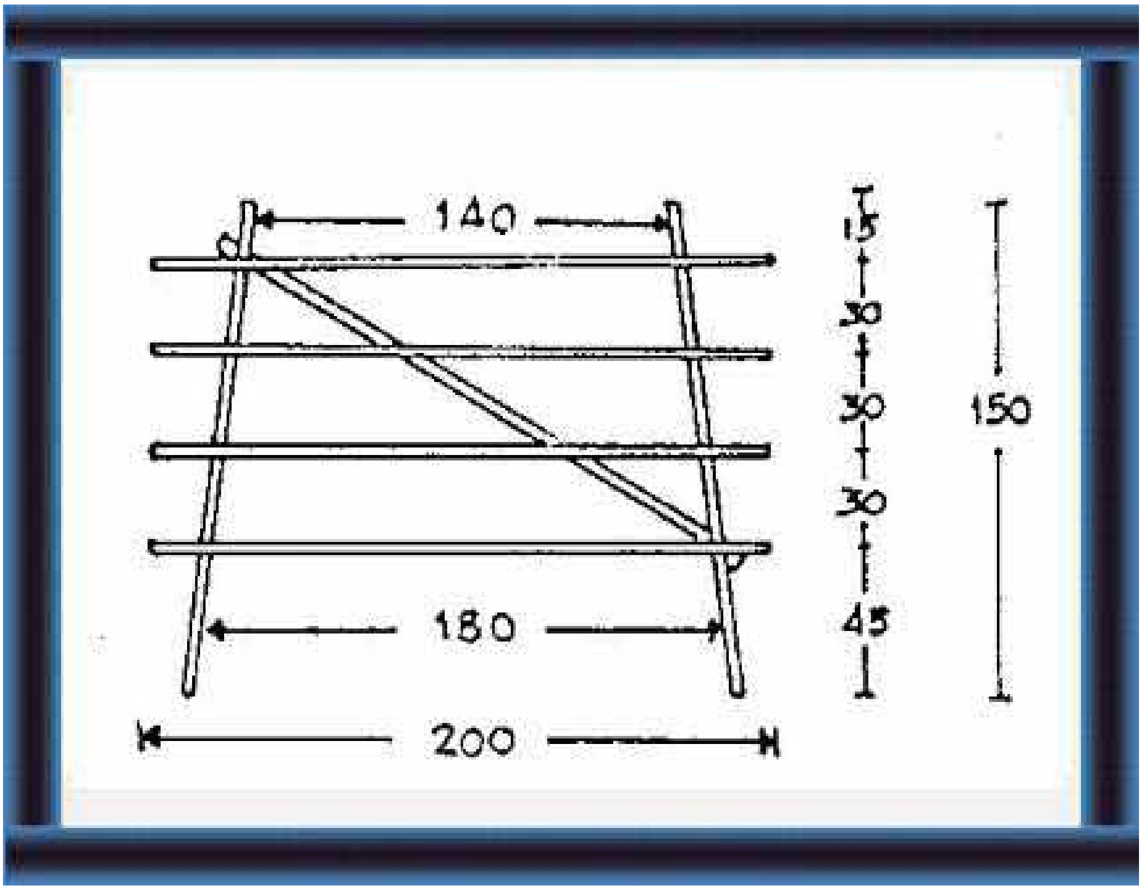
Small-Scale

Dairy Farming Manual

Volume 3

Husbandry Unit 5.3

SMALL SCALE HAY MAKING



Extension Materials

What should you know about hay making?

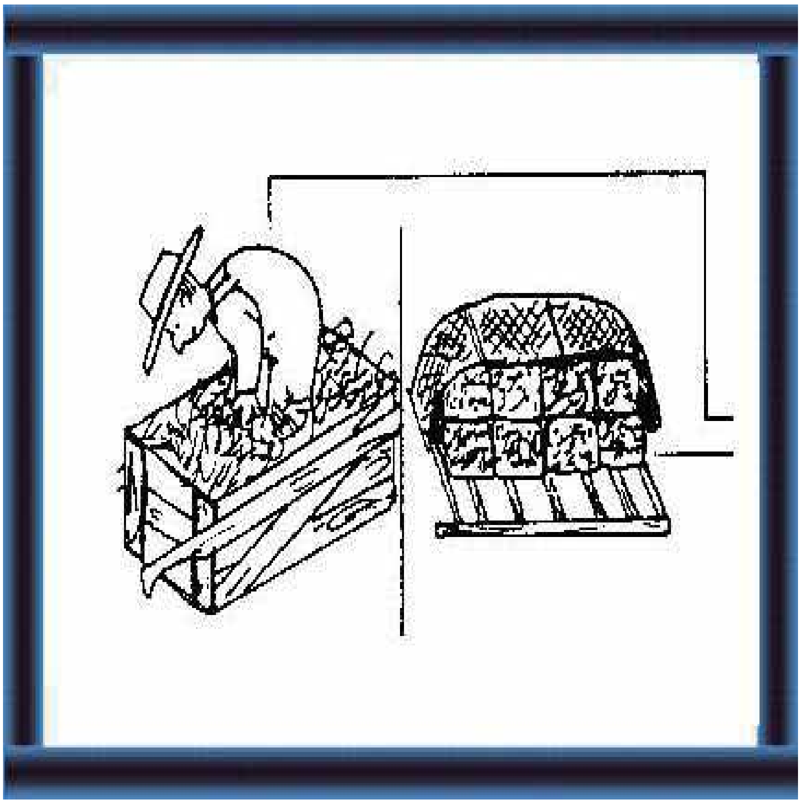
What is hay and why is feeding hay important?

(5-20)

1 You should know:
- the **feed value** of hay
- the **importance** of **feeding hay** when there is **no grass**.

When do you cut and how do you dry your hay crop? (21-47)

2 You should know about:
- **equipment**
- **time** of cutting
- **ways** of drying.



How do you bale and store hay?(48-74)

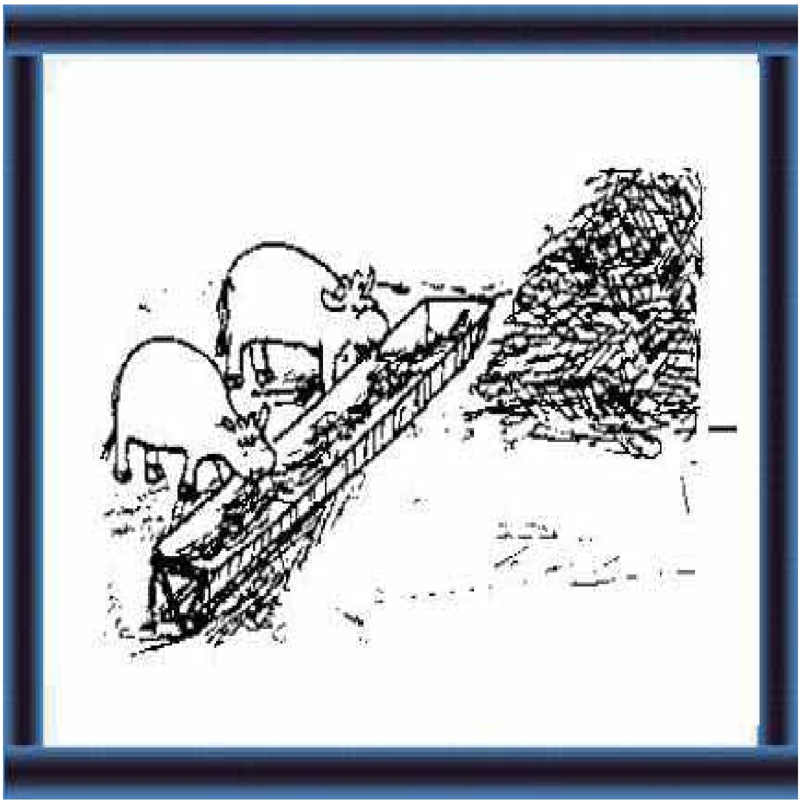
3 You should know how to:
- make and use a **baling box**
- make a hay **store** and **keep your hay dry**.

How can you feed hay? (75-80)

4 You should know how to make **feeders** for your:
- calves
- cows.

What do you make hay from?

5 **During the rains** there is **more grass** than at any other time of the year.

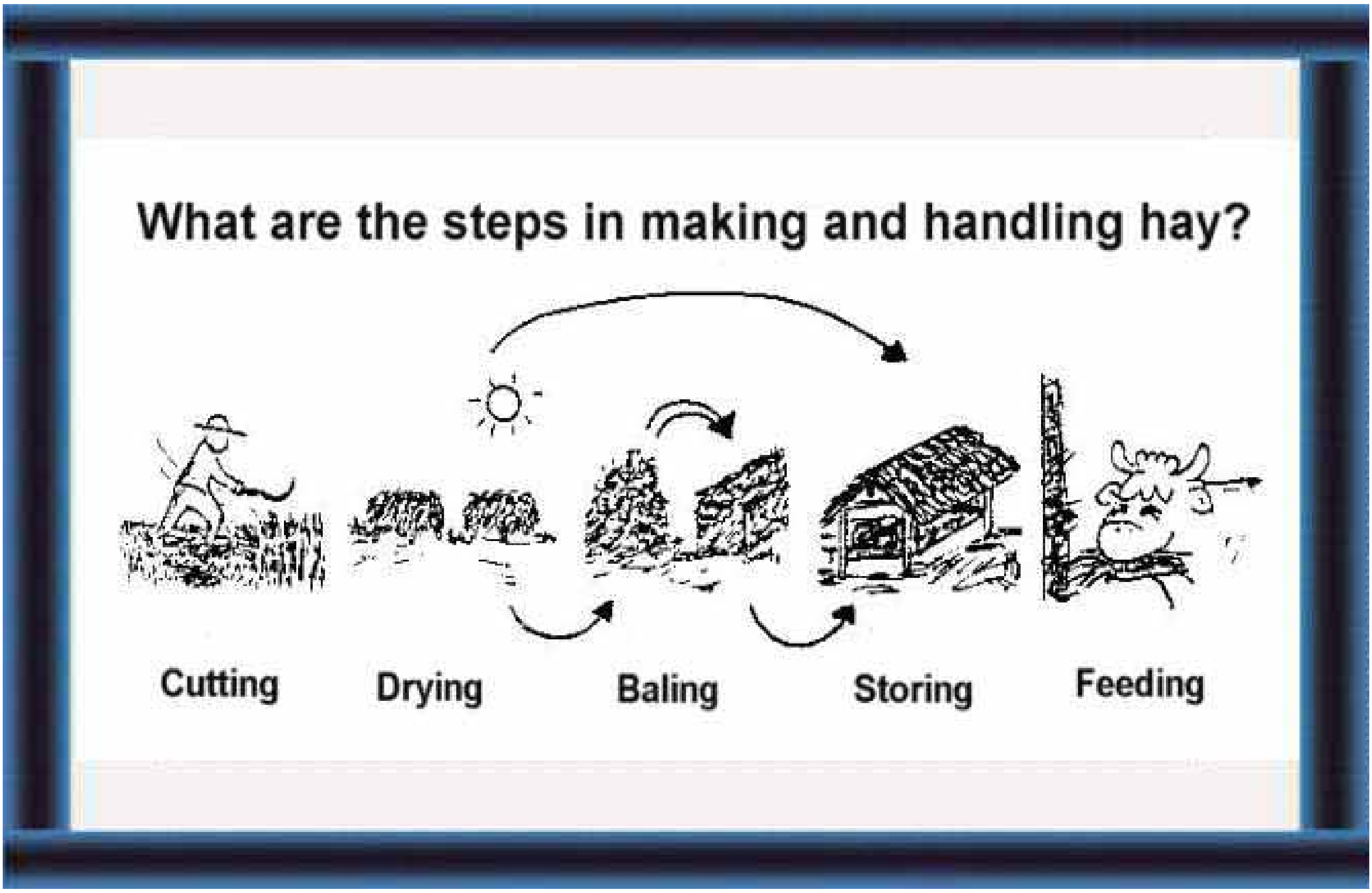


6 There is **enough** grass for **fresh feeding**.
There is also a **surplus** of grass.

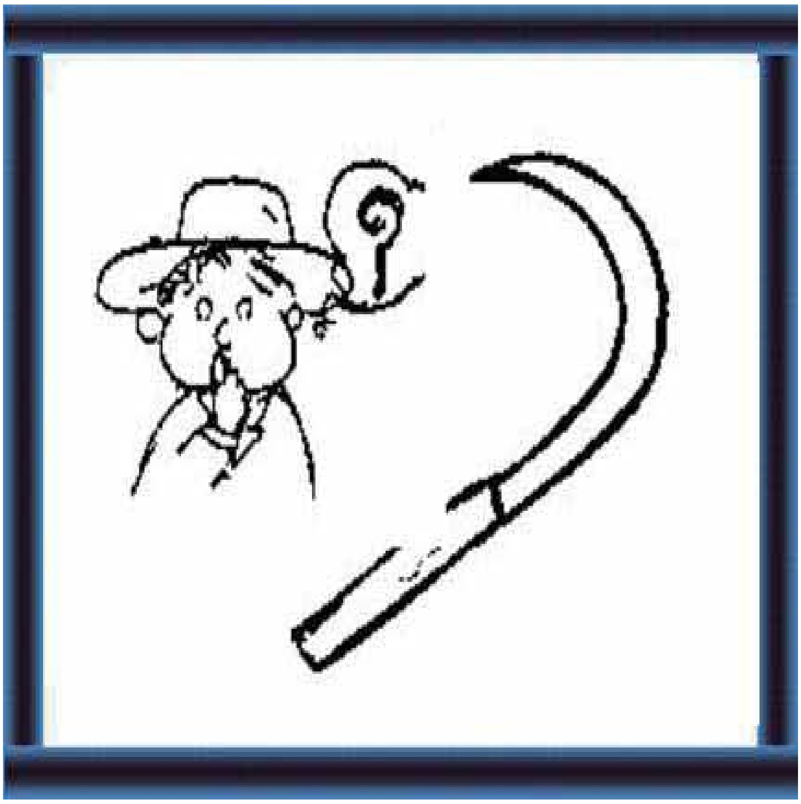
7 You can turn this surplus forage into **silage** or **hay**.

What are the steps in making and handling hay?

8 Cutting Drying Baling Storing Feeding



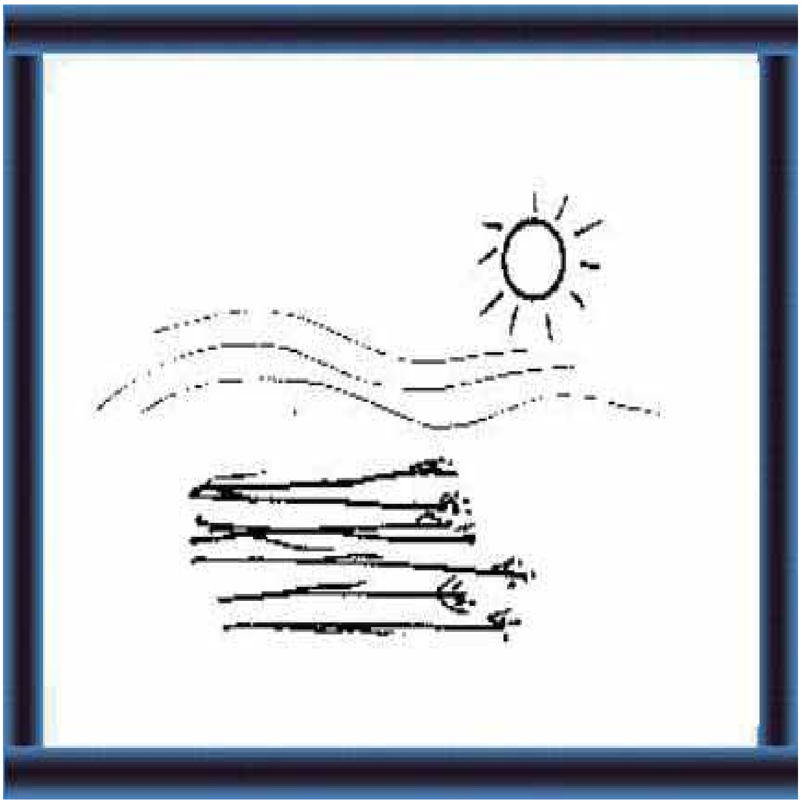
What is hay?



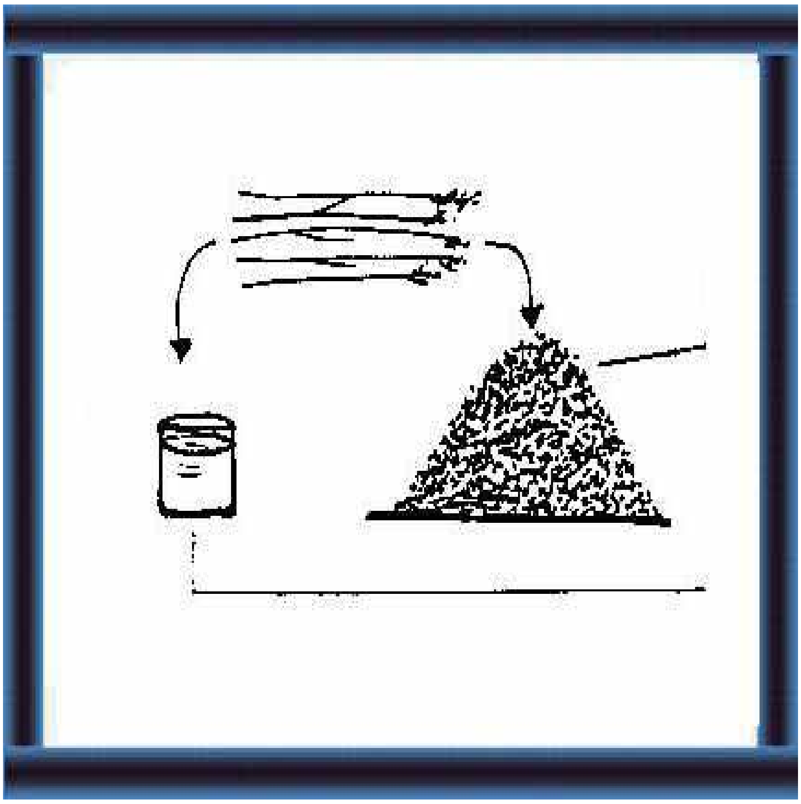
9 **Grass** or **legumes** which you cut at the **beginning** of **flowering**.

At this time your hay crops:
- are rich in **protein**
- are low in **fibre**
- give high yields of **green matter**.

10 Grass or legumes which you **dry quickly** in



the sun and wind to:
- **reduce** the **water content** of fresh plant matter
- **preserve** the **nutrients**.

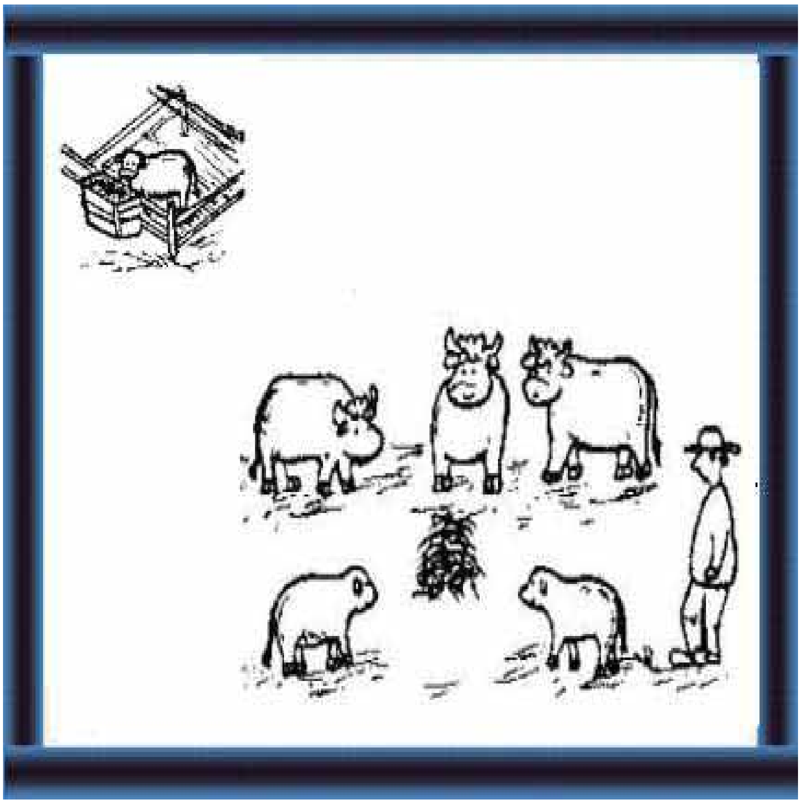


11 Hay contains about **80% dry matter** and **20% water**.

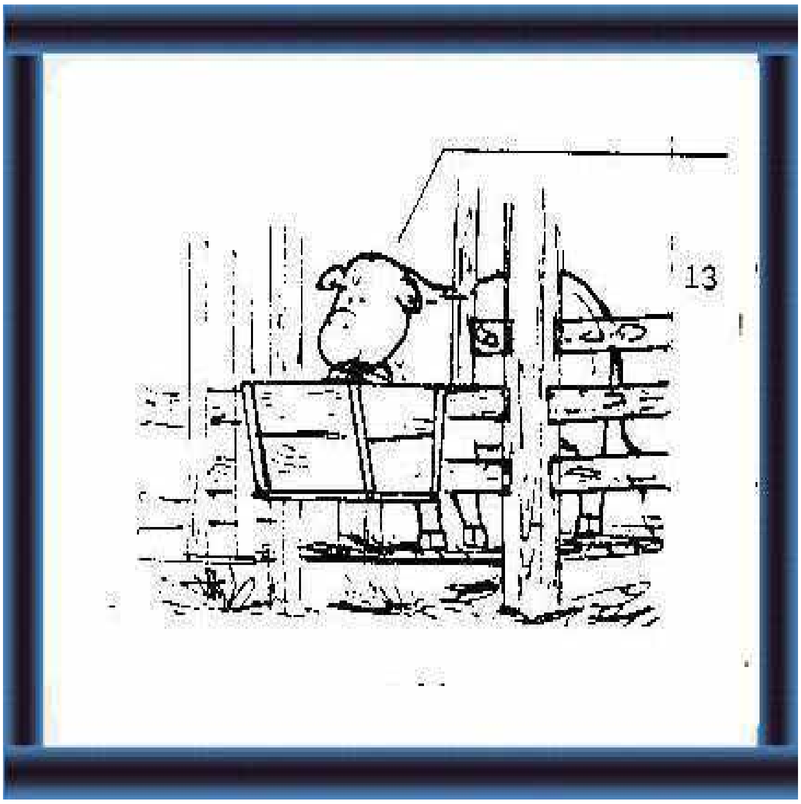
Quality hay is green in colour and smells good.

Green hay contains:
- **carotene**
- **B complex vitamins**
- **vitamin D**.

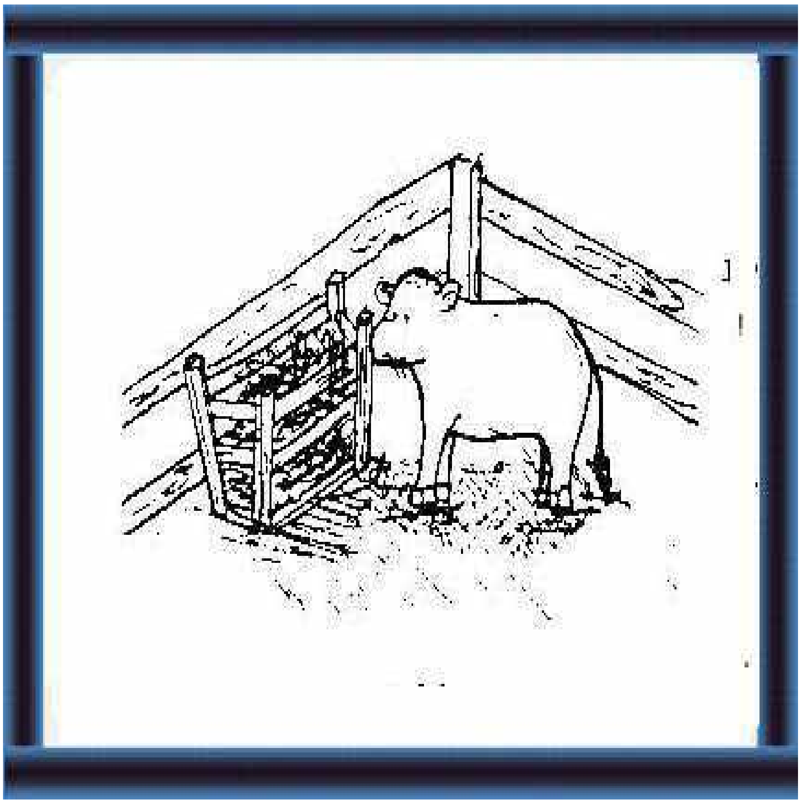
Why is feeding hay important?



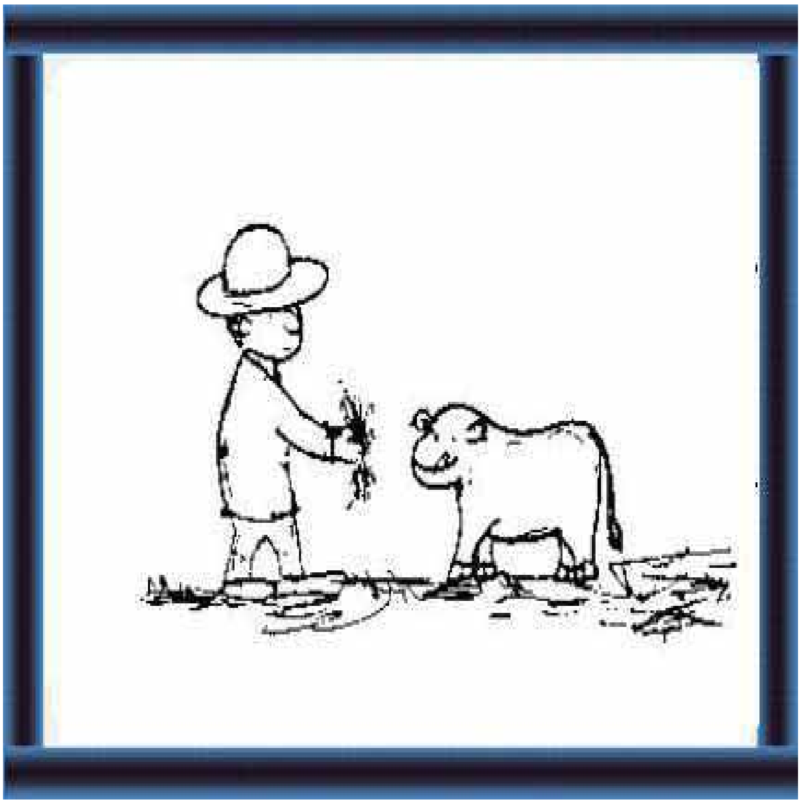
12 There may **not** be **enough grass** to make hay for all your cows and calves



13 but you can **produce enough hay** for your **calves**.
They need it most.



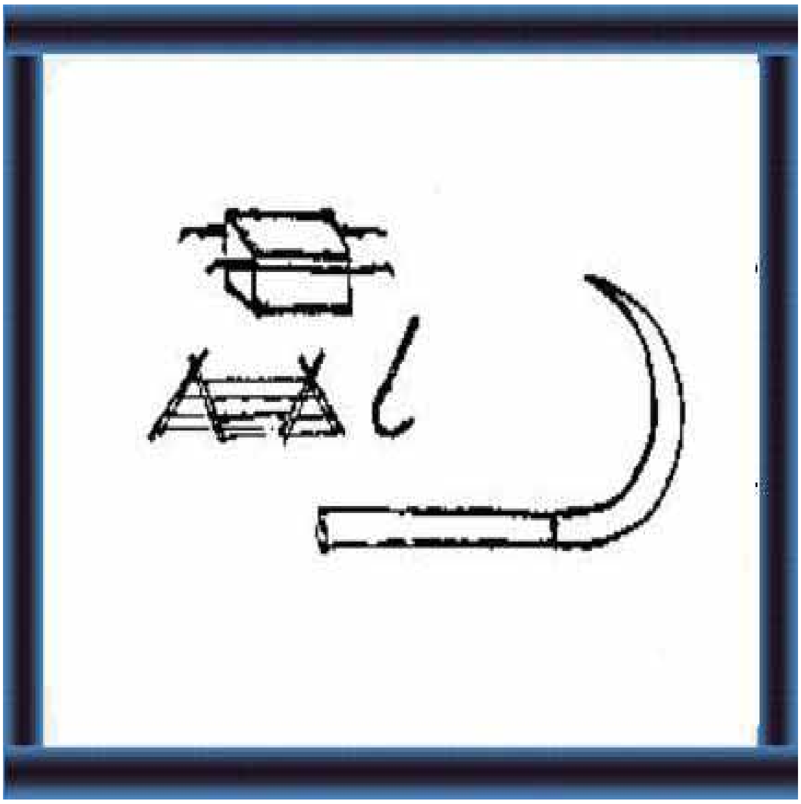
14 At **two weeks old**, feed **one handful** of **hay every day**.
Gradually increase the amount.



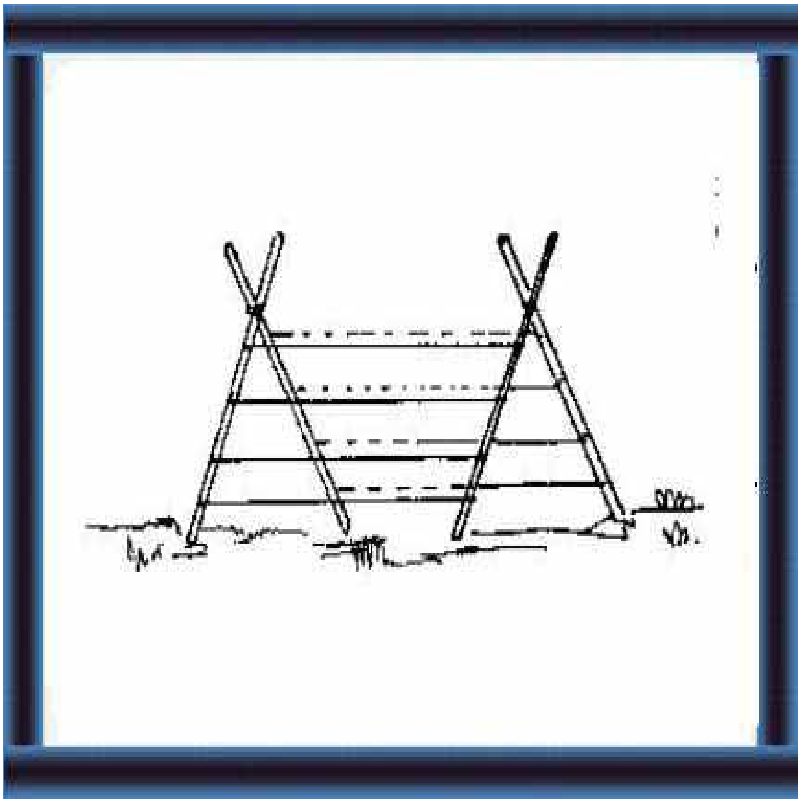
15 Feeding hay to young calves:

- **maintains growth** when there is no grass
- helps the **development of the rumen**
- **reduces milk consumption** in liquid feeding so you can **deliver more milk to the collecting centre**.

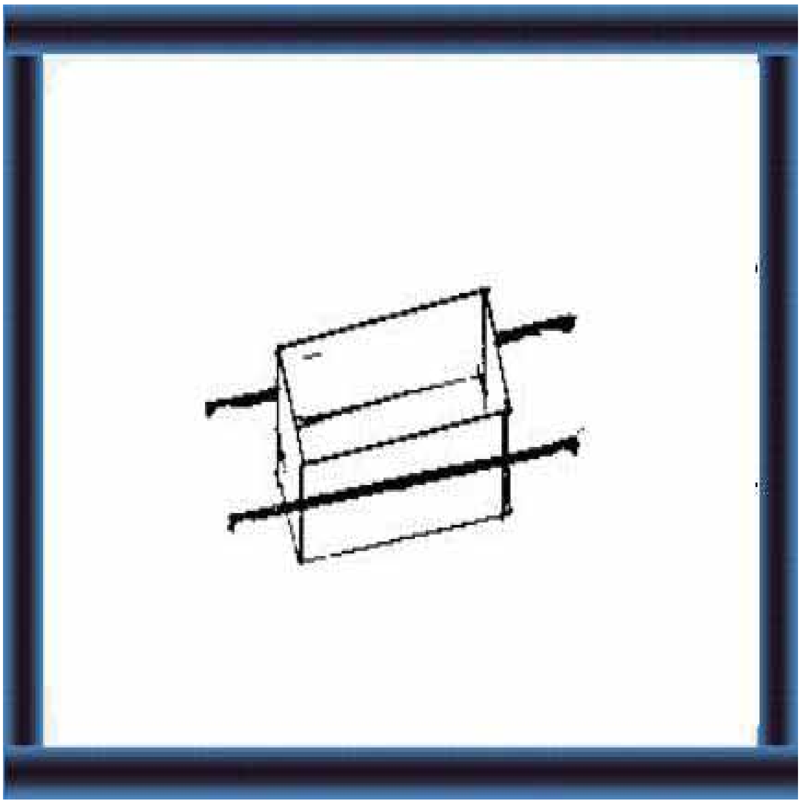
What equipment do you need to make and handle hay?



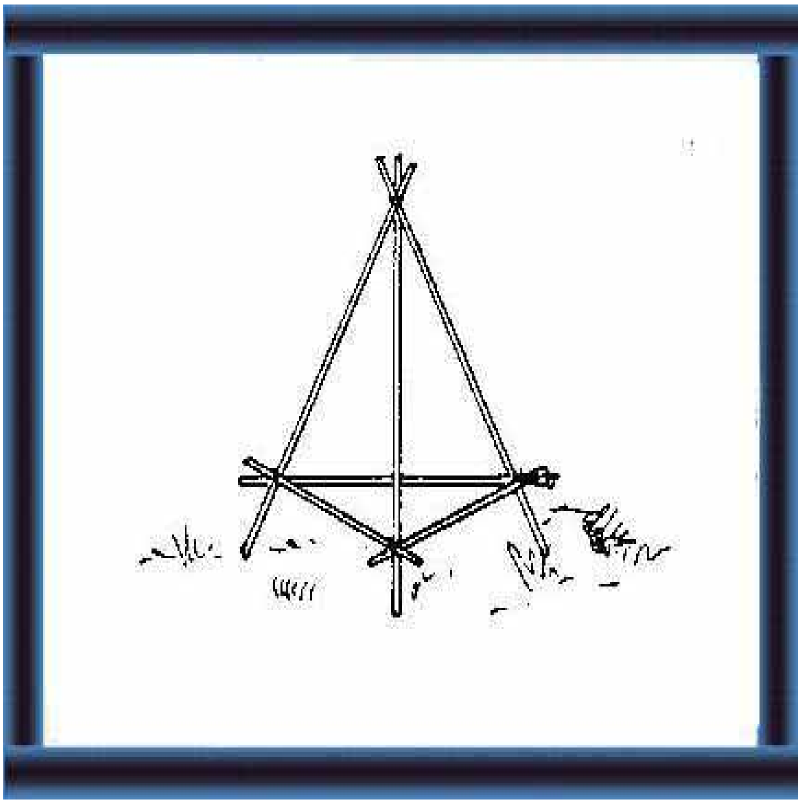
16 A **sickle** for **cutting** the hay crop.



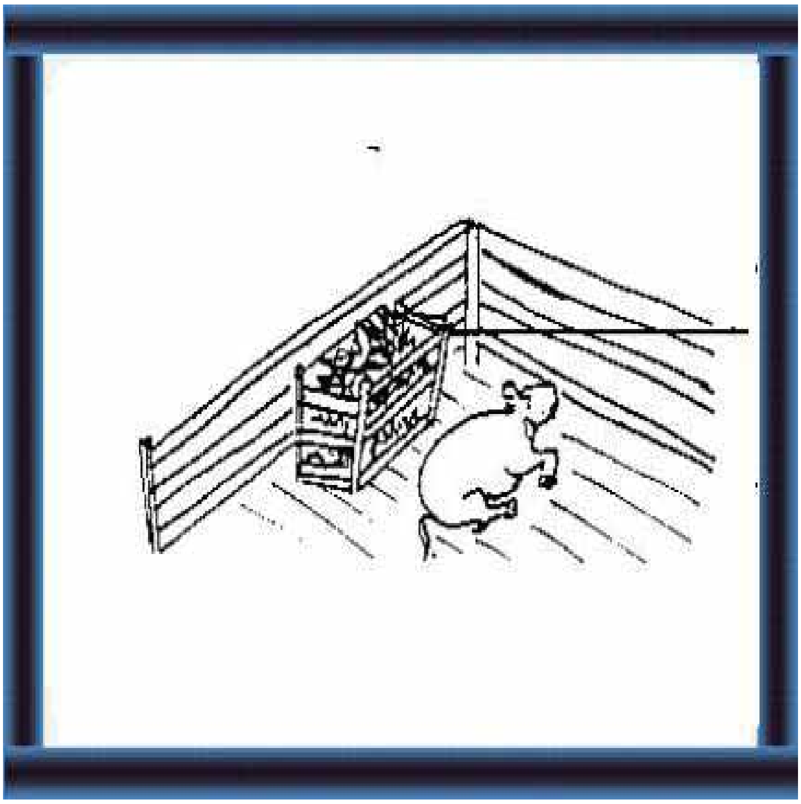
17 A **rack** for keeping the crop **off the ground** while drying it.



18 A **wooden box** for making the hay into **bales**.



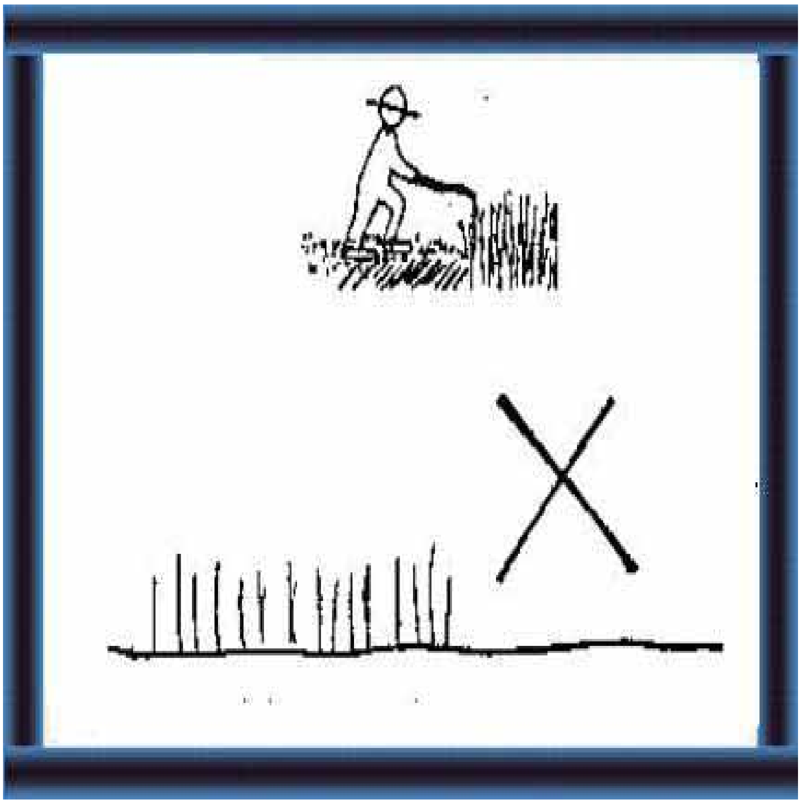
19 A **structure with a roof** for **storing** the hay and keeping it **dry**.



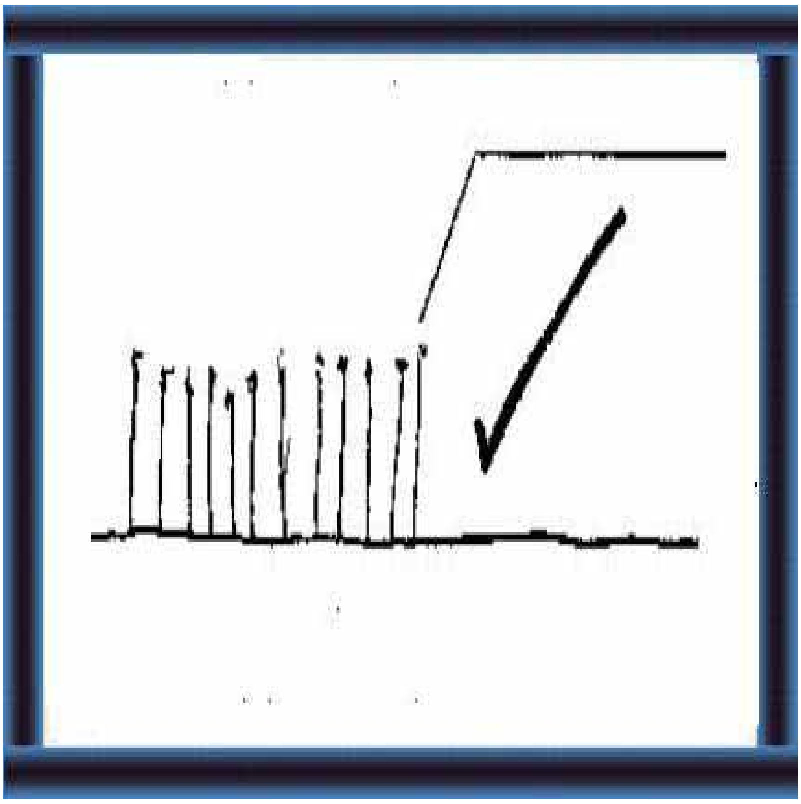
20 A **rack** for **feeding** the calves.

When do you cut your hay crop?

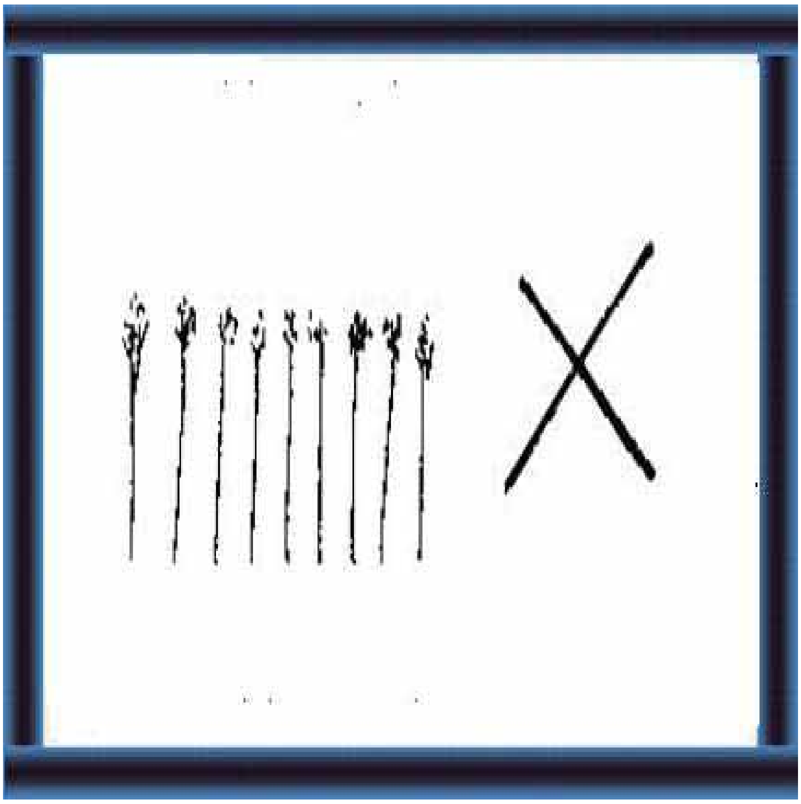
21 At the **right time**.



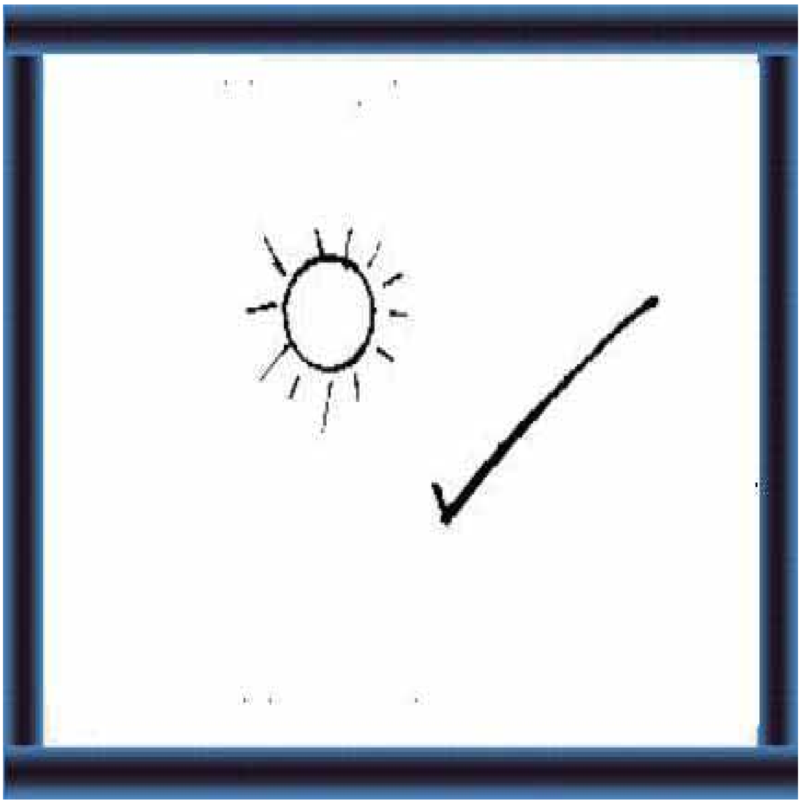
Too early:
- not enough green matter.



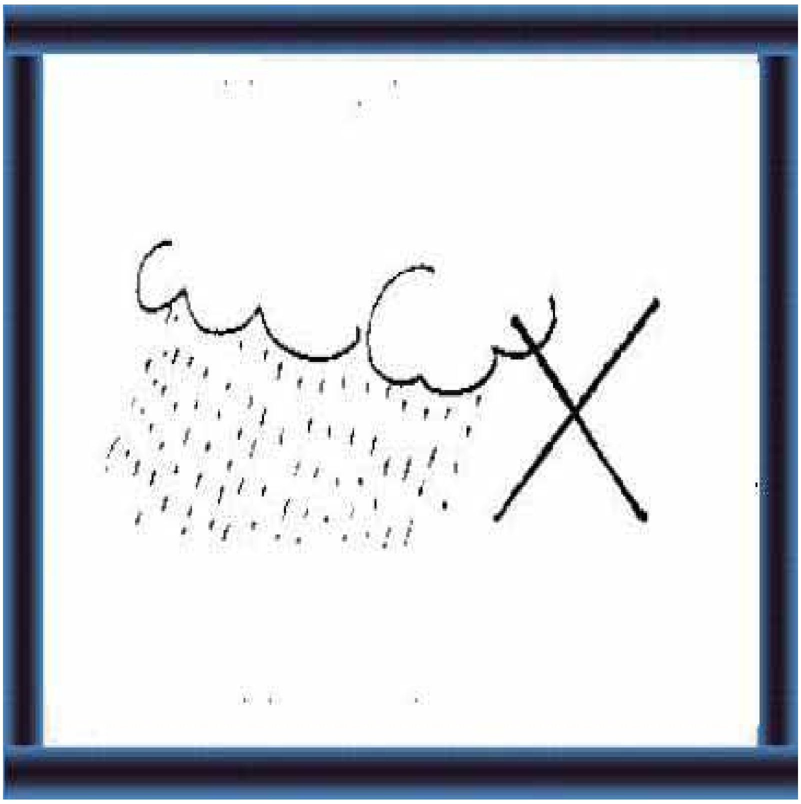
22 When the hay crop **starts flowering:**
- at this time, the crop has **maximum nutrients** and **green matter**.



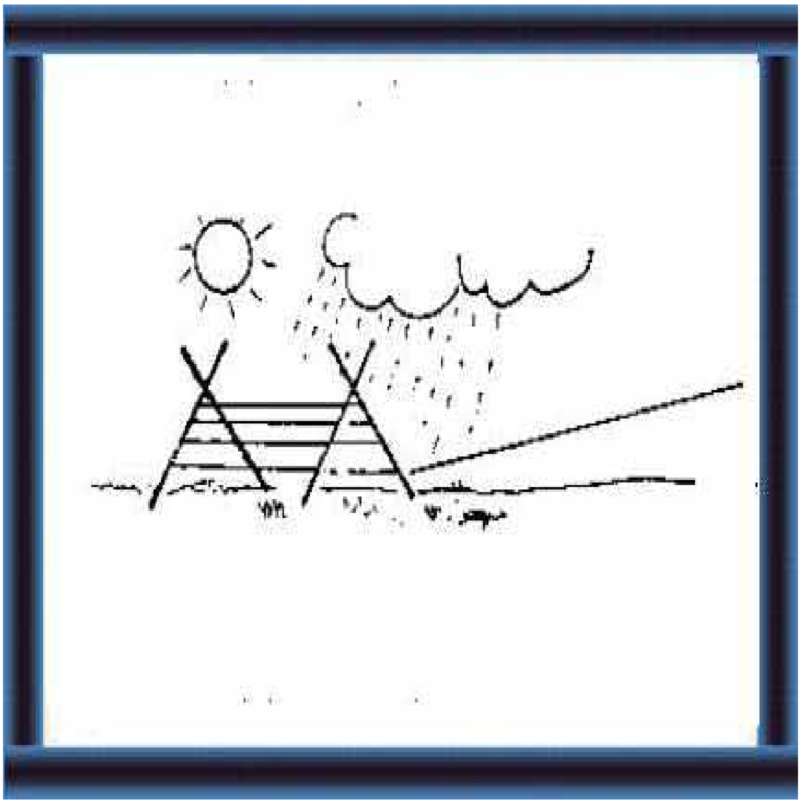
23 **Too late:**
- too low in protein
- too high in fibre.



24 **When the weather is dry**.



25 **Too wet:**
- at this time, the crop will dry **more quickly** but **do not wait** for **sunshine**.

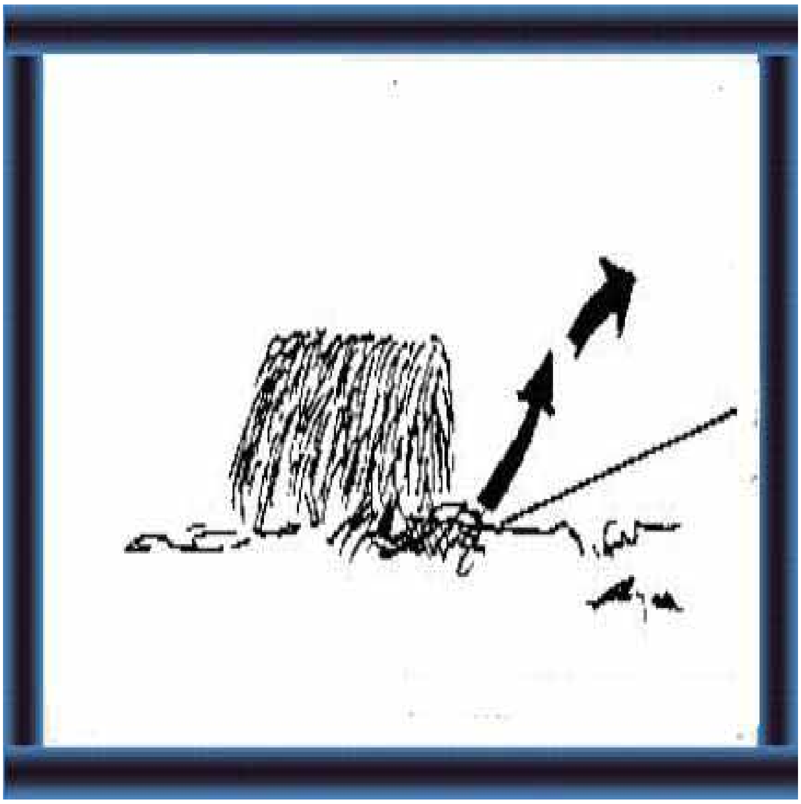


26 A **drying rack** can help you to **overcome your problems** with the **weather**.

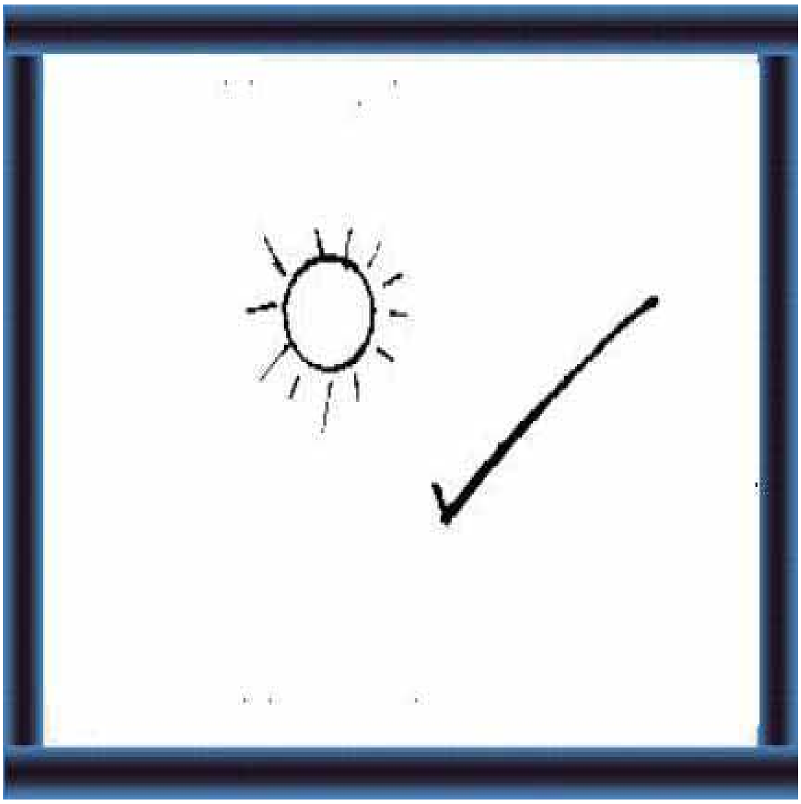
How can you dry the hay crop quickly?

27 After cutting the hay crop, **turn over often** to help **wilt** all parts of the crop.

28 **Load** hay onto a **drying rack**.



29 **Take away plant matter** which **touches the ground**.

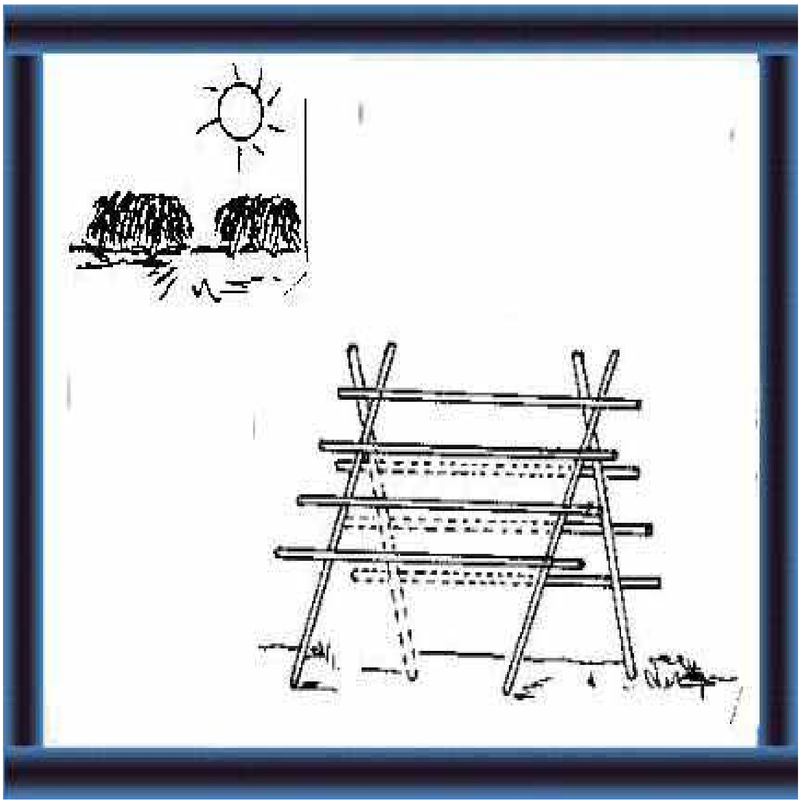


30 **Cover** the rack with **mats before** it becomes **wet** by rain.

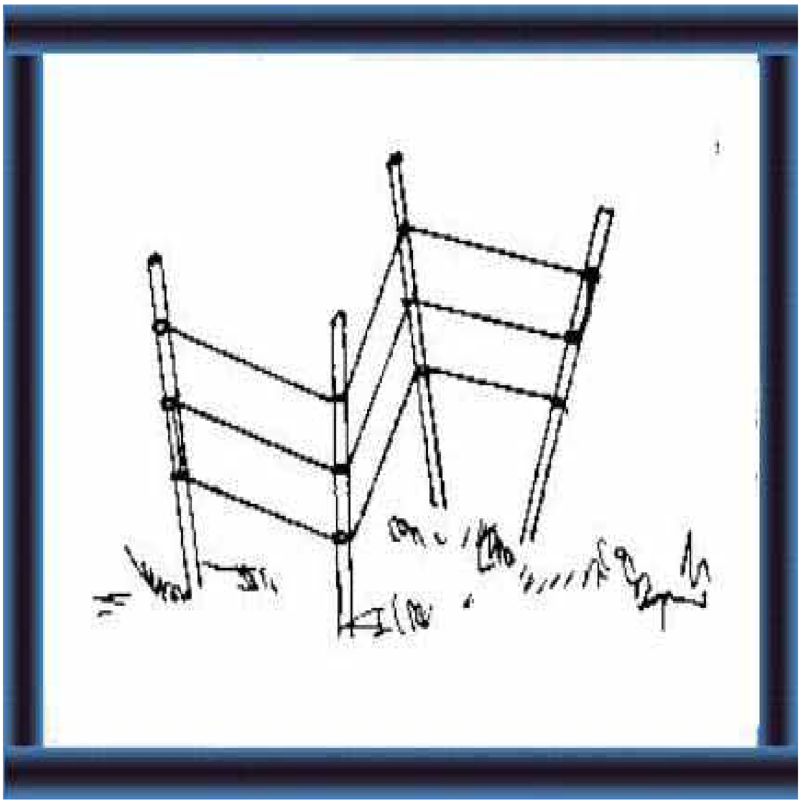
31 If you do not have enough mats to cover the sides, **brush** the **hay downwards** so that it **sheds rain**.

What kind of drying racks can you use?

Hurdle
32 The hurdle:



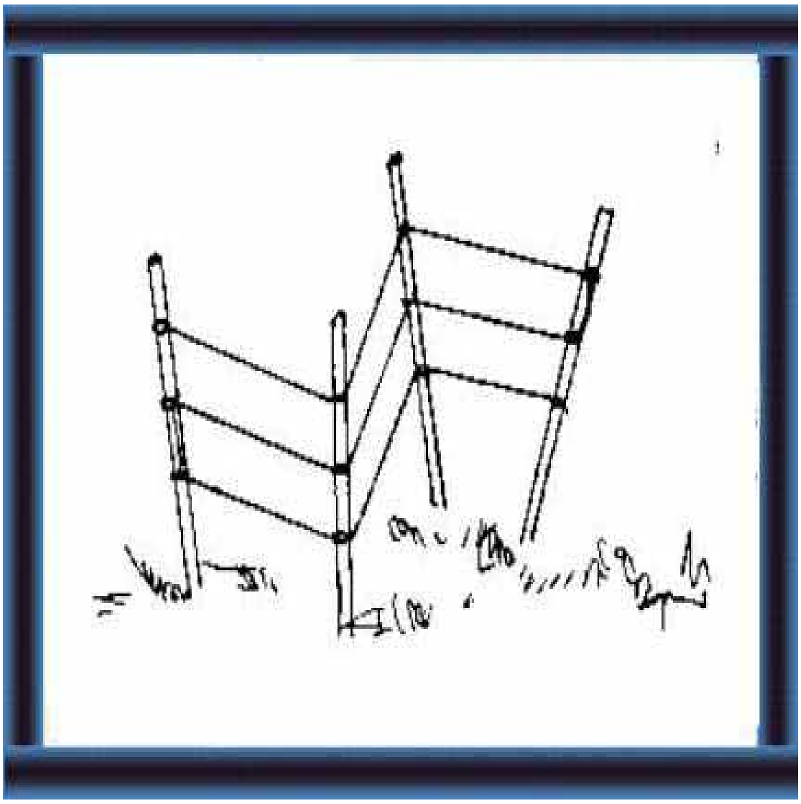
- is **suitable** for **smallholders**
- has a capacity of **30-40 kg**
- is **easy to assemble**.



Heinz

33 The heinz:

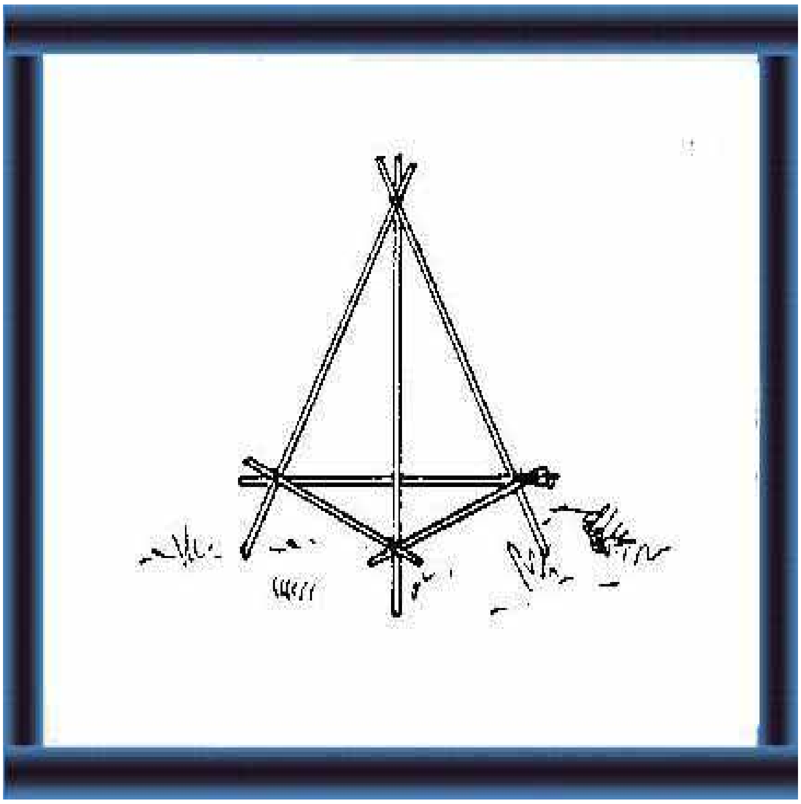
- is **suitable** for all **weather conditions**
- is **easy to make and assemble**
- requires a **plastic tent**.



Fence

34 The fence:

- requires **little material**
- has a capacity of **80 kg** (4 poles)
- can be **loaded with wet hay**
- requires **careful assembly**.

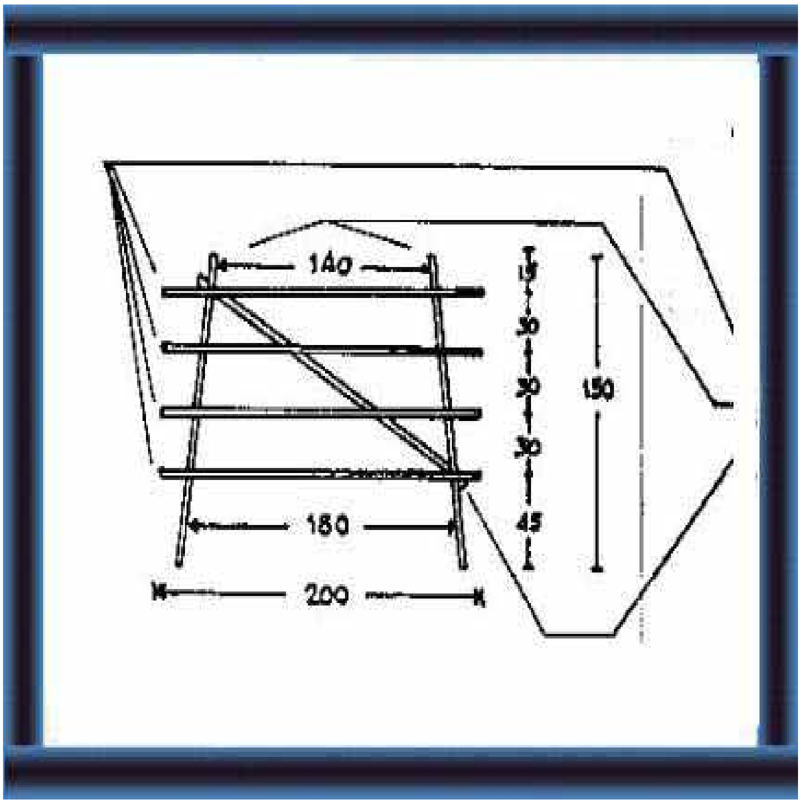


Tripod

35 The tripod:

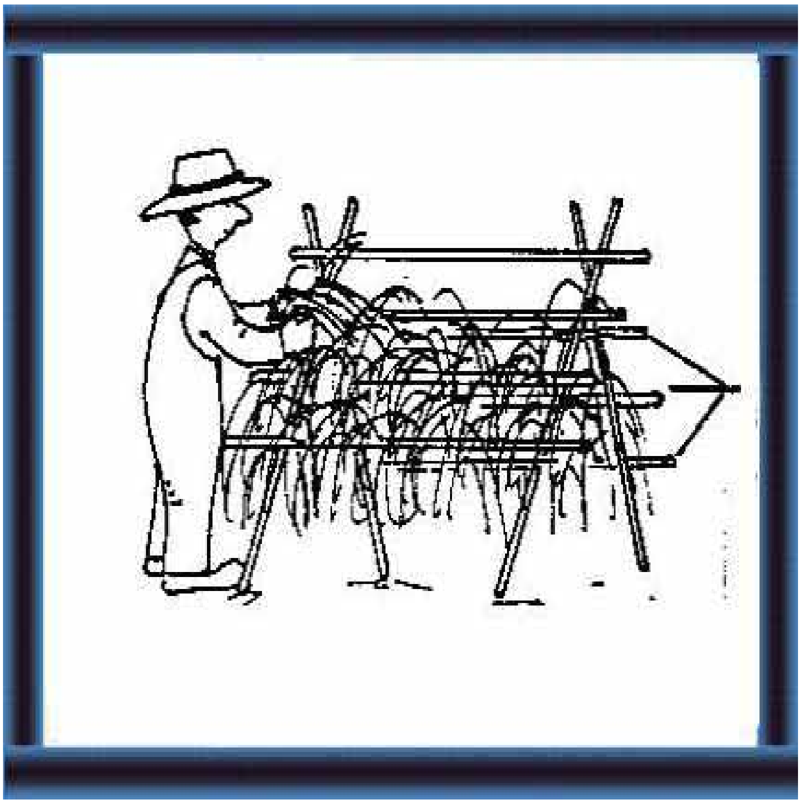
- is better in **dry climates**
- leads to **moulding** in high humidities.

How can you make a hurdle?



36 **You need:**

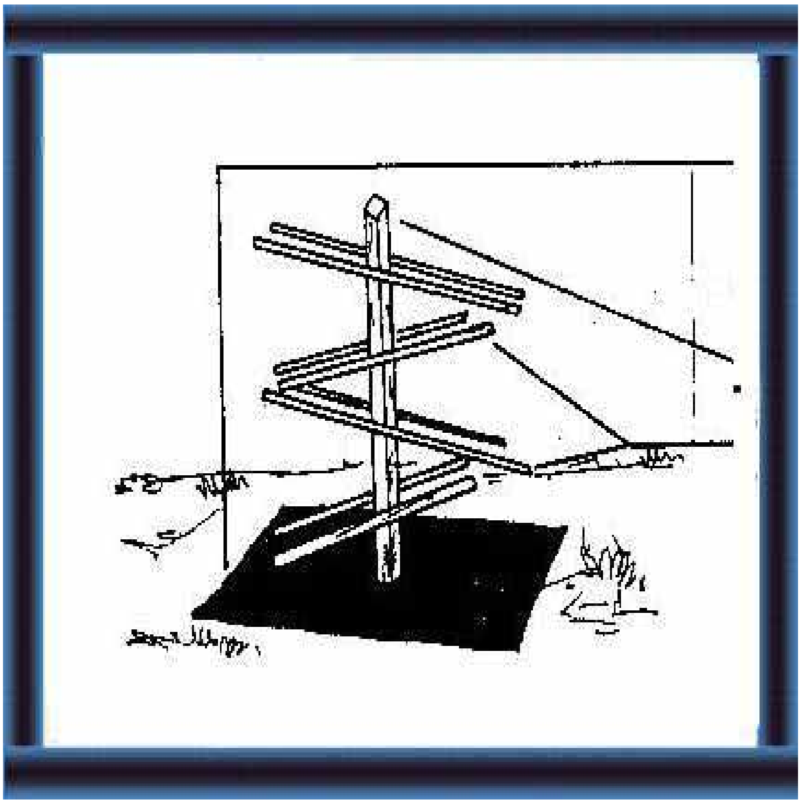
8 poles : 200 x 8 x 5 cm
4 poles : 150 x 8 x 5 cm
2 poles : 165 x 8 x 5 cm
Tie, nail or screw the poles together to make two frames like this.



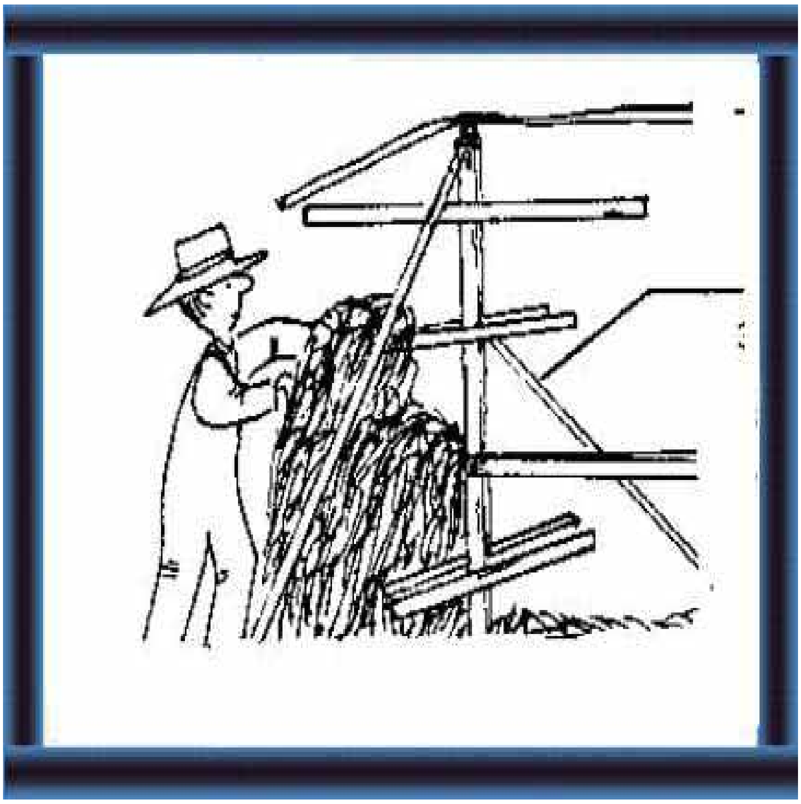
37 Lean one frame against the other to make the hurdle.

Load the hay crop onto the **horizontal bars**.

How can you make a heinz?

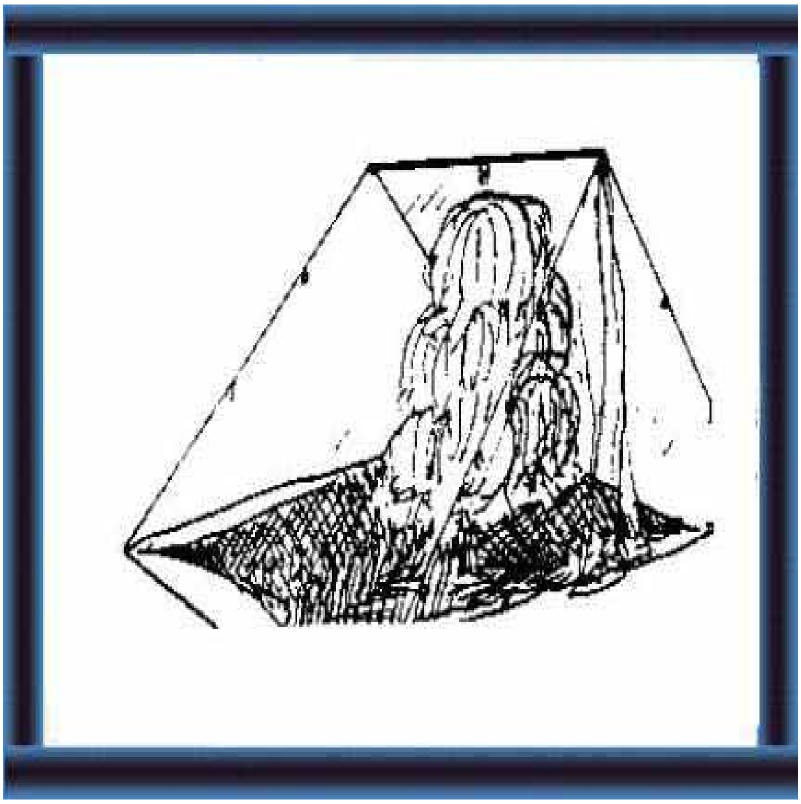


38 Lay a **dark plastic sheet** on the ground to **collect** the **sun's rays**.
Put a **thick pole** into the ground.
Fix **thinner poles** in horizontal positions at right angles.



39 Fix **support poles** and a **roof pole**.
Load the **hay crop** onto the horizontal arms.

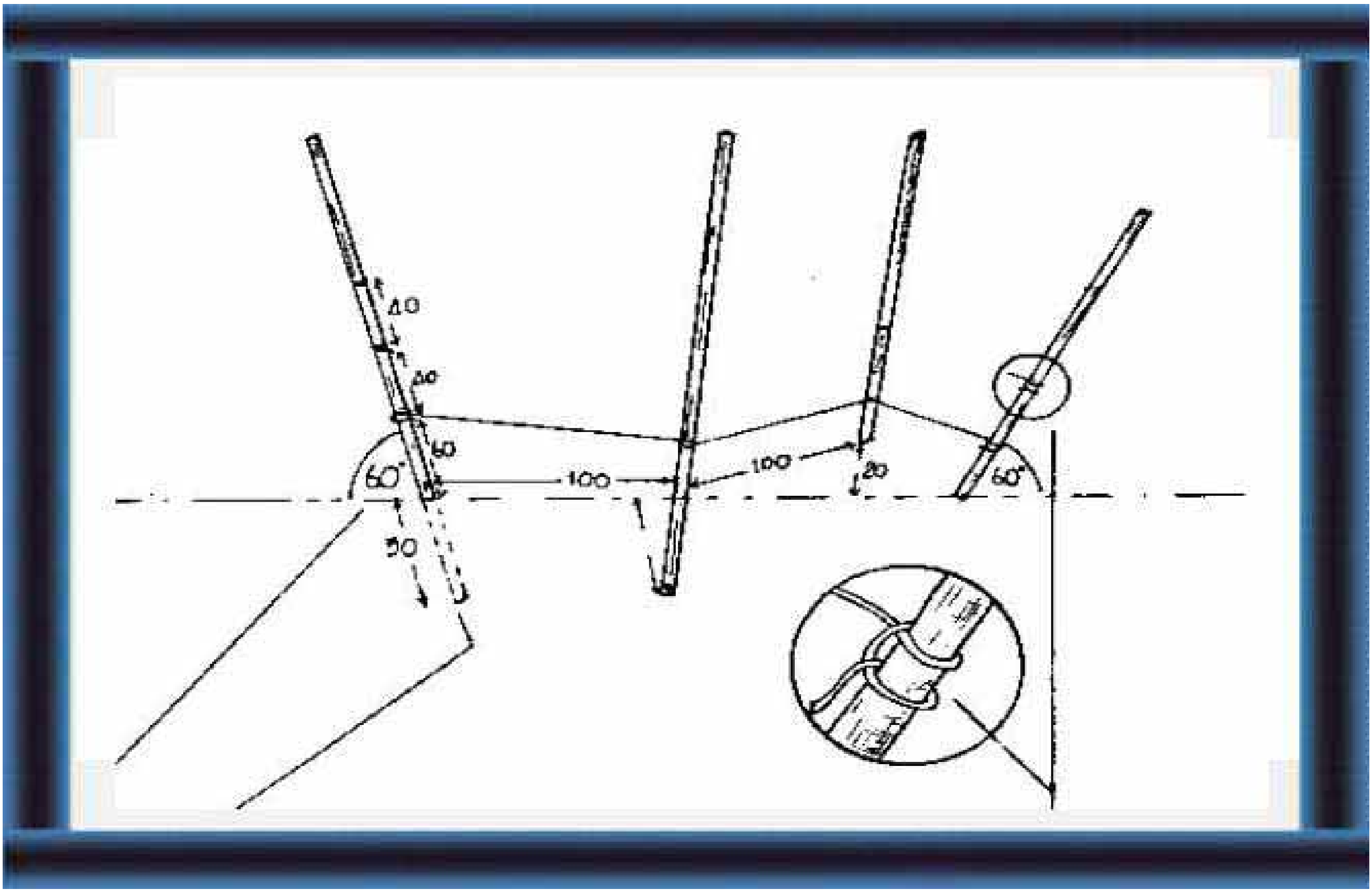
40 **Cover** with a **clear plastic sheet** to **protect from rain**.



41 After about **two days** the hay is **dry** and you can **remove it**.

How can you make a fence?

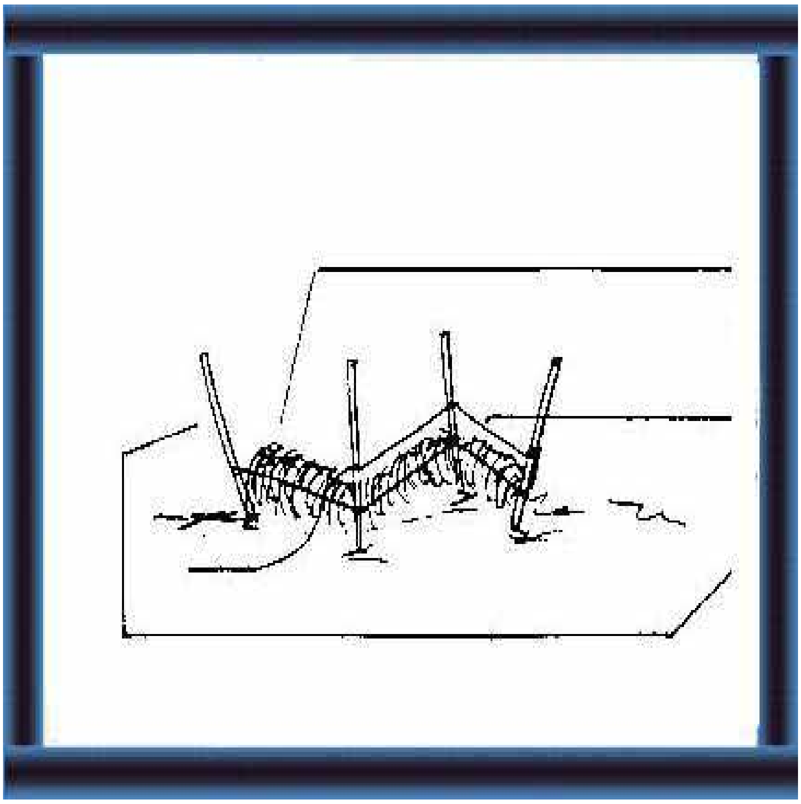
42 You need:
- 4, 5 or more **round poles**, 240 x 8 x 5 cm
- a **bar** to make holes
- **sisal** or **ropes**.



Make holes in the ground with a bar. **Note** the **angle** of the poles!

Make holes in the ground with a bar. **Note** the **angle** of the poles!

Tie the rope to the poles for the **first layer** of hay.



43 **Load** the **first layer** of **hay crop** on the **rope**.

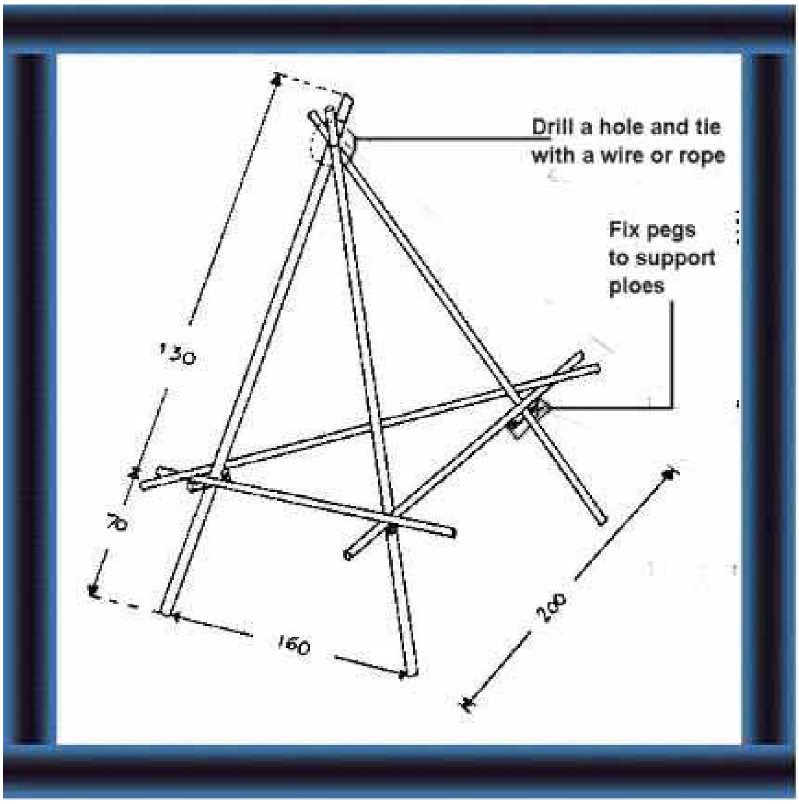
Then tie the **second rope** on **top** and **add** the **second layer of hay**.

Continue to tie ropes and add layers of hay.

How can you make a tripod?

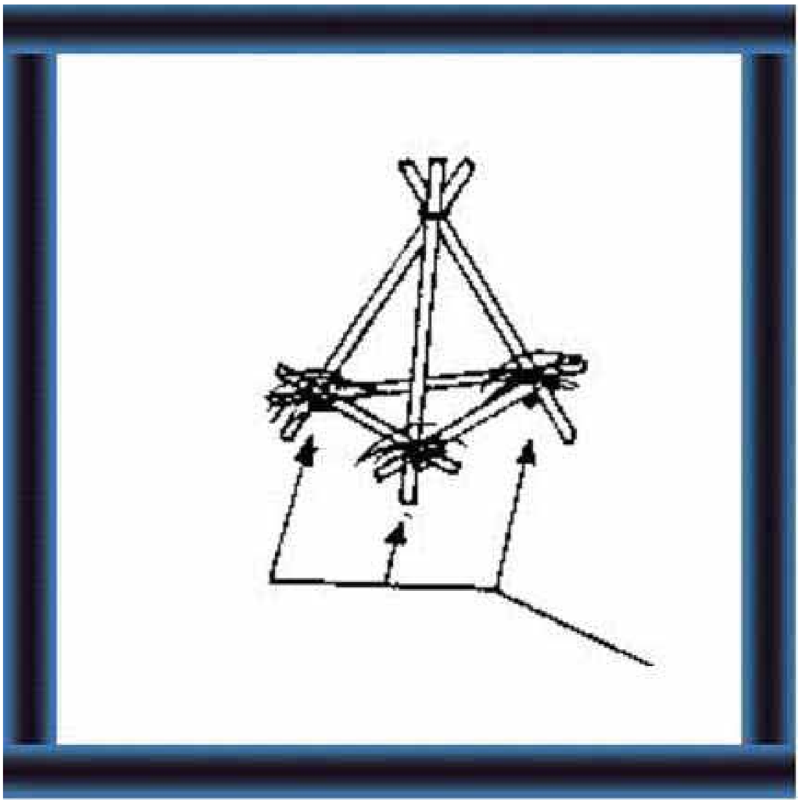
44 You need:

3 poles : 200 x 8 cm

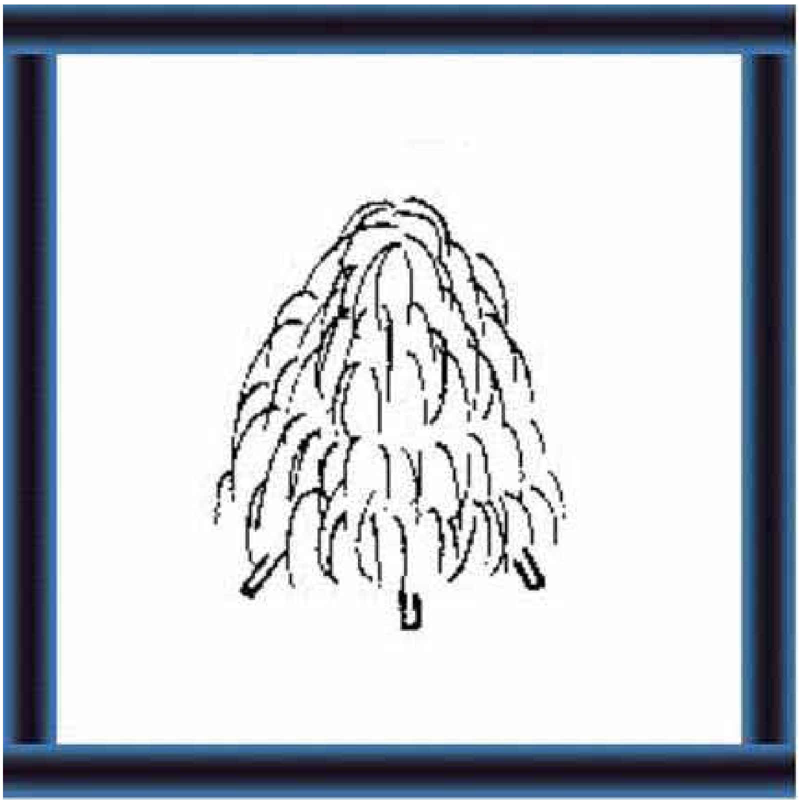


3 poles : 200 x 8 cm
3 pegs : 30 x 8 cm
Drill a hole and tie with wire or rope.

Fix pegs to support poles.



46 Begin loading from all three corners. Then move towards the middle.

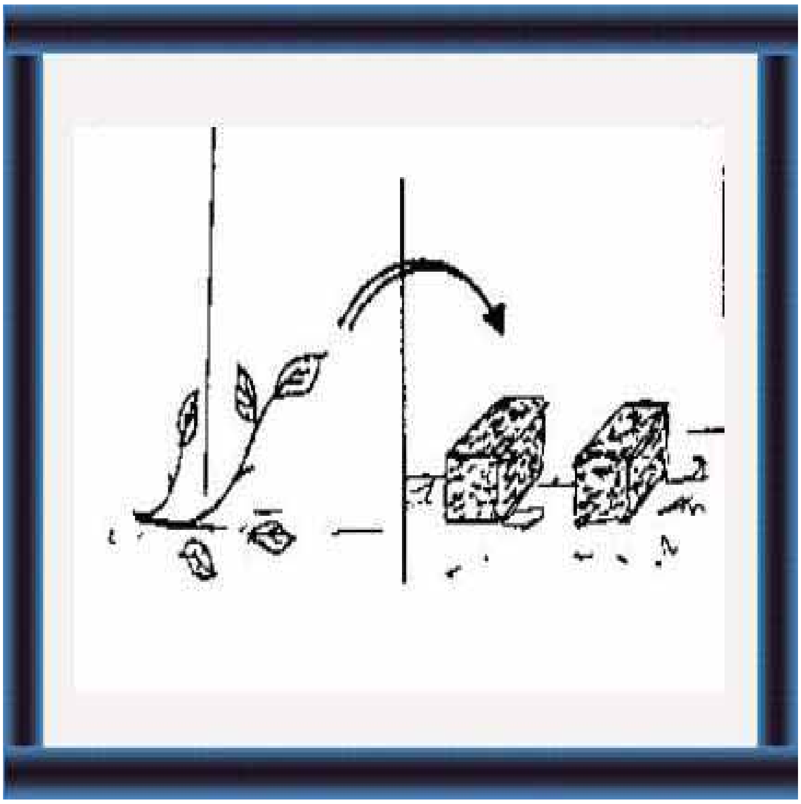


47 Load the hay to form a cone. Keep the surface area small.

A tripod can carry about **500 kg of grass**.

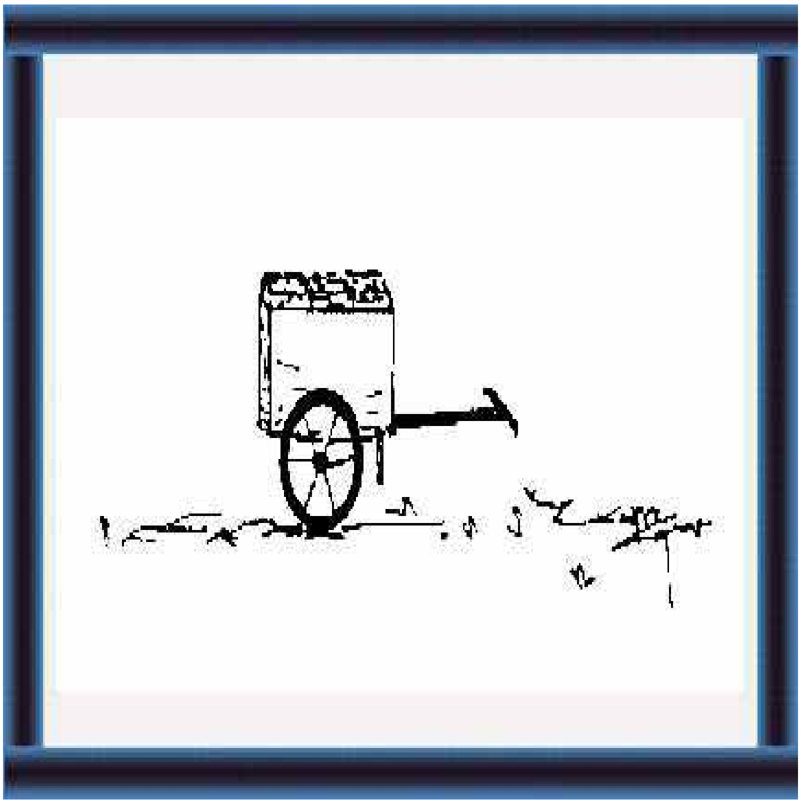
Why should you bale hay?

48 Legumes cut for hay **lose their leaves** easily.



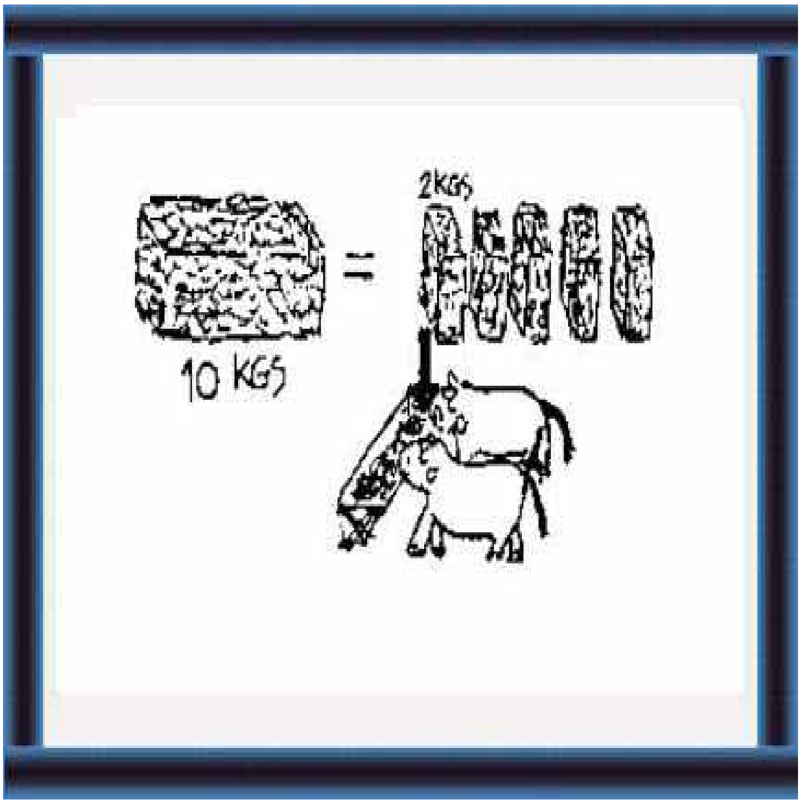
Baling keeps the leaves **in the bale** - from the field to the feeder.

49 Baled hay is **easy to handle**.



50 It is **easy to transport**

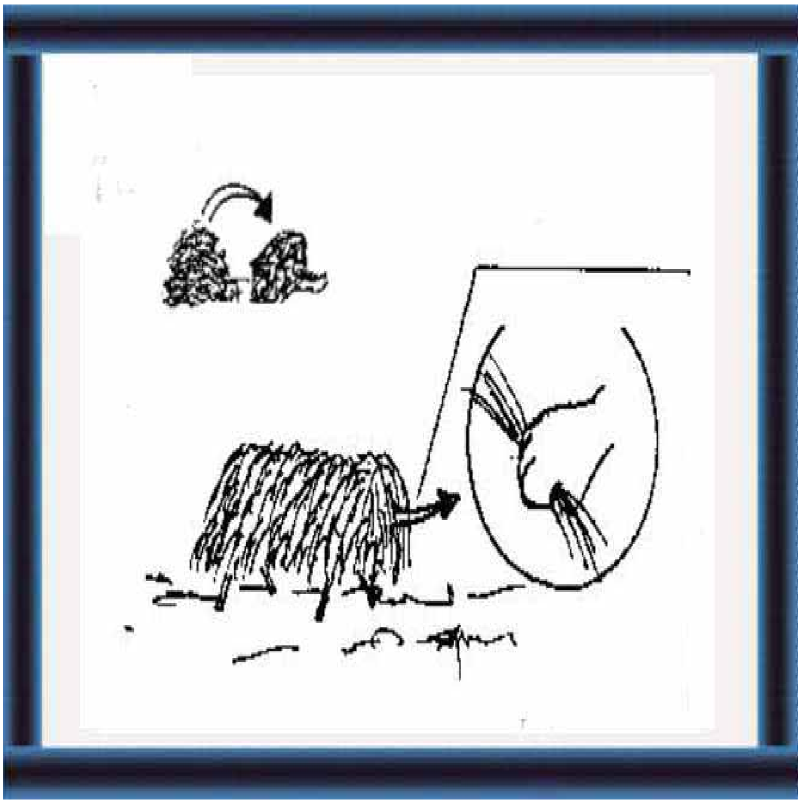
51 **easy to store**



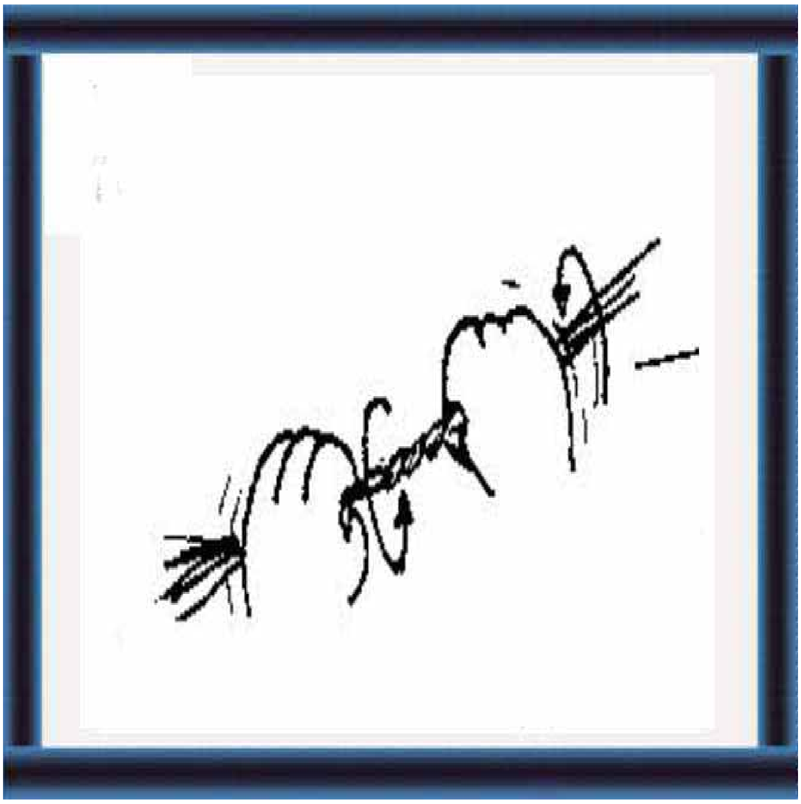
52 and **easy to ration** at feeding time.

How do you know when hay is dry enough to bale or store?

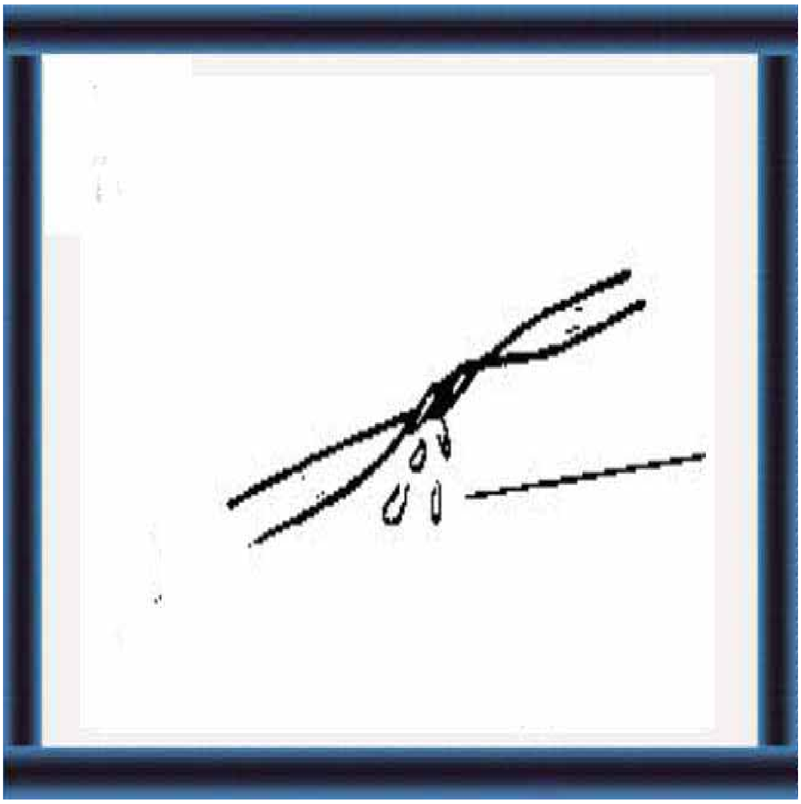
53 Take a handful of hay



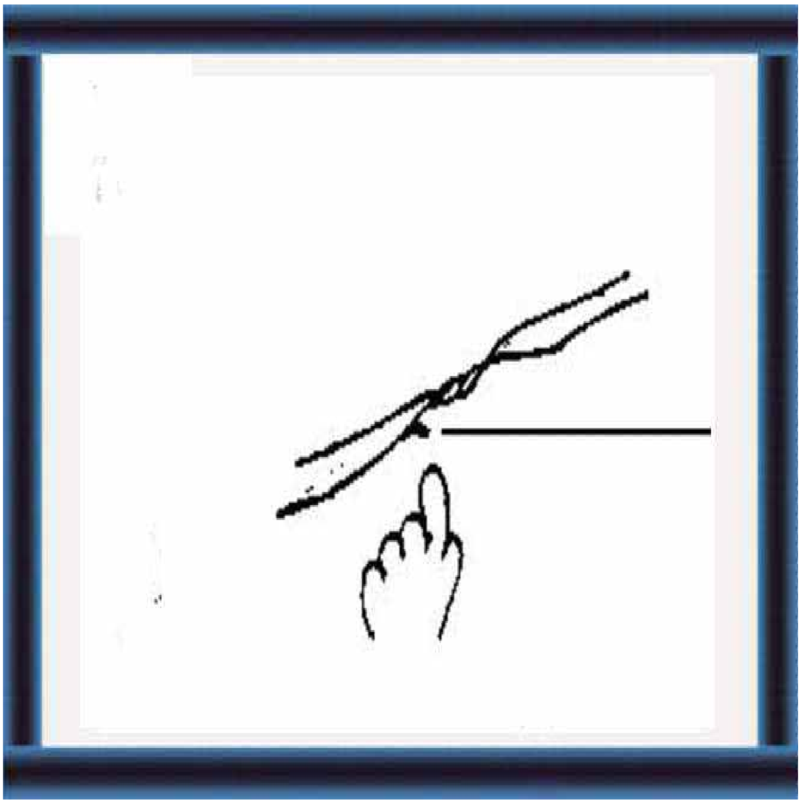
from the **inner layers** of the drying rack.



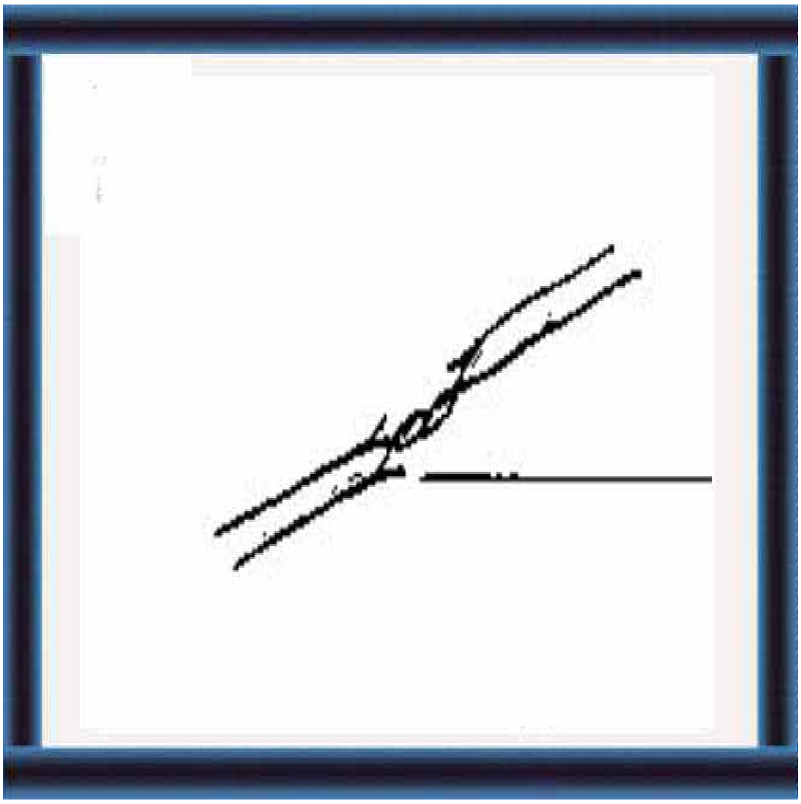
54 **Twist** the hay by hand and look at it **carefully**:



55 Does **not break**.
Shows **moisture**.
Do not store the hay.
Dry longer.

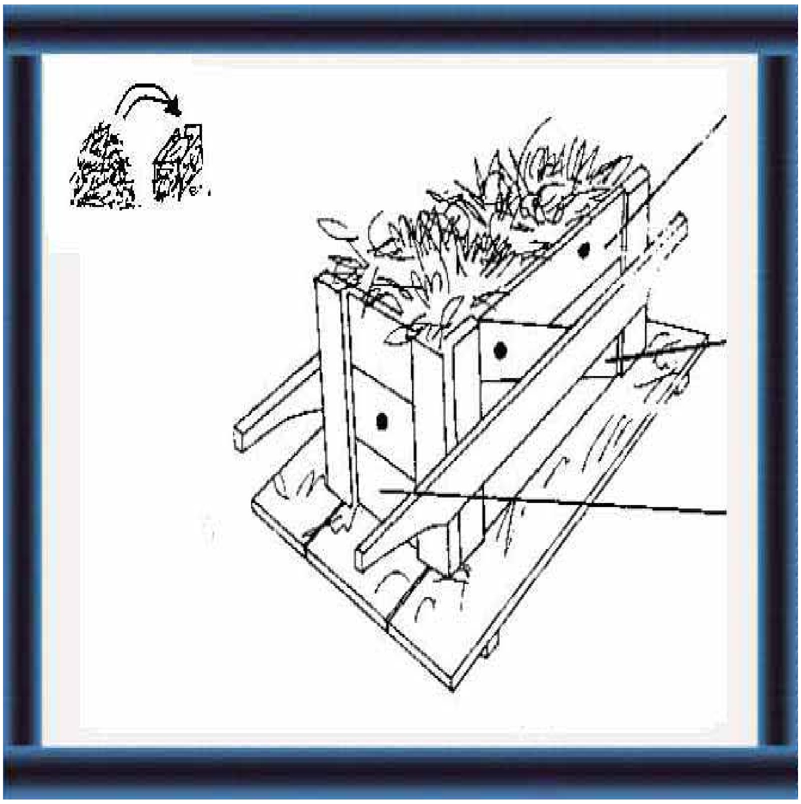


56 **Skin comes off**.
Do not store the hay.
Dry longer.



57 **Breaks** a **little**.
Shows **no moisture**.
Store the hay.

How can you make a baling box?

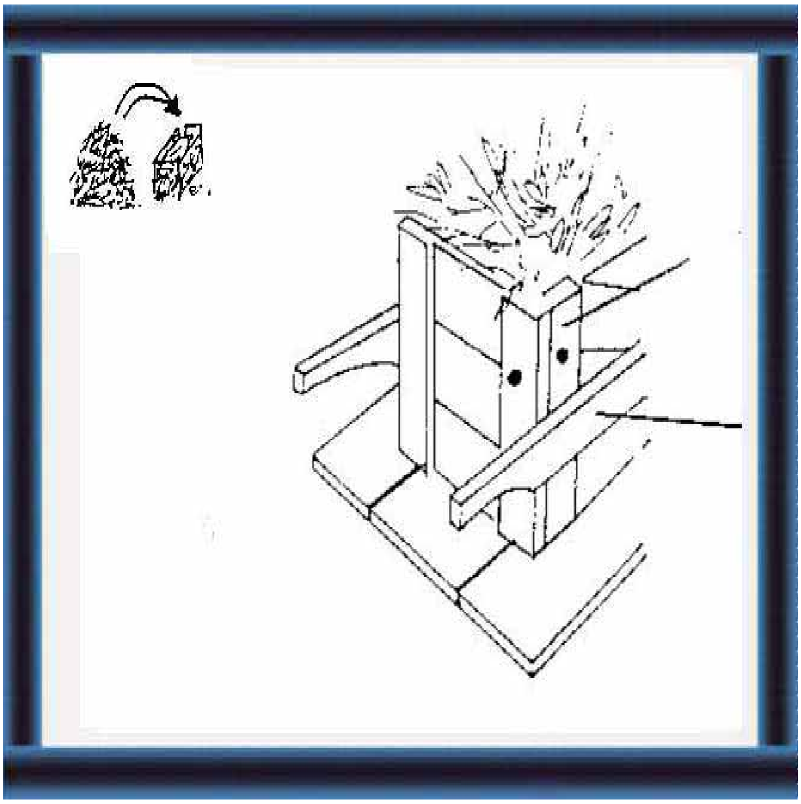


You need:
58

Side boards: 6 pieces 65 x 12 x 2 cm

Cross bars: 2 pieces 50 x 15 x 2 cm

End boards: 6 pieces 36 x 12 x 2 cm

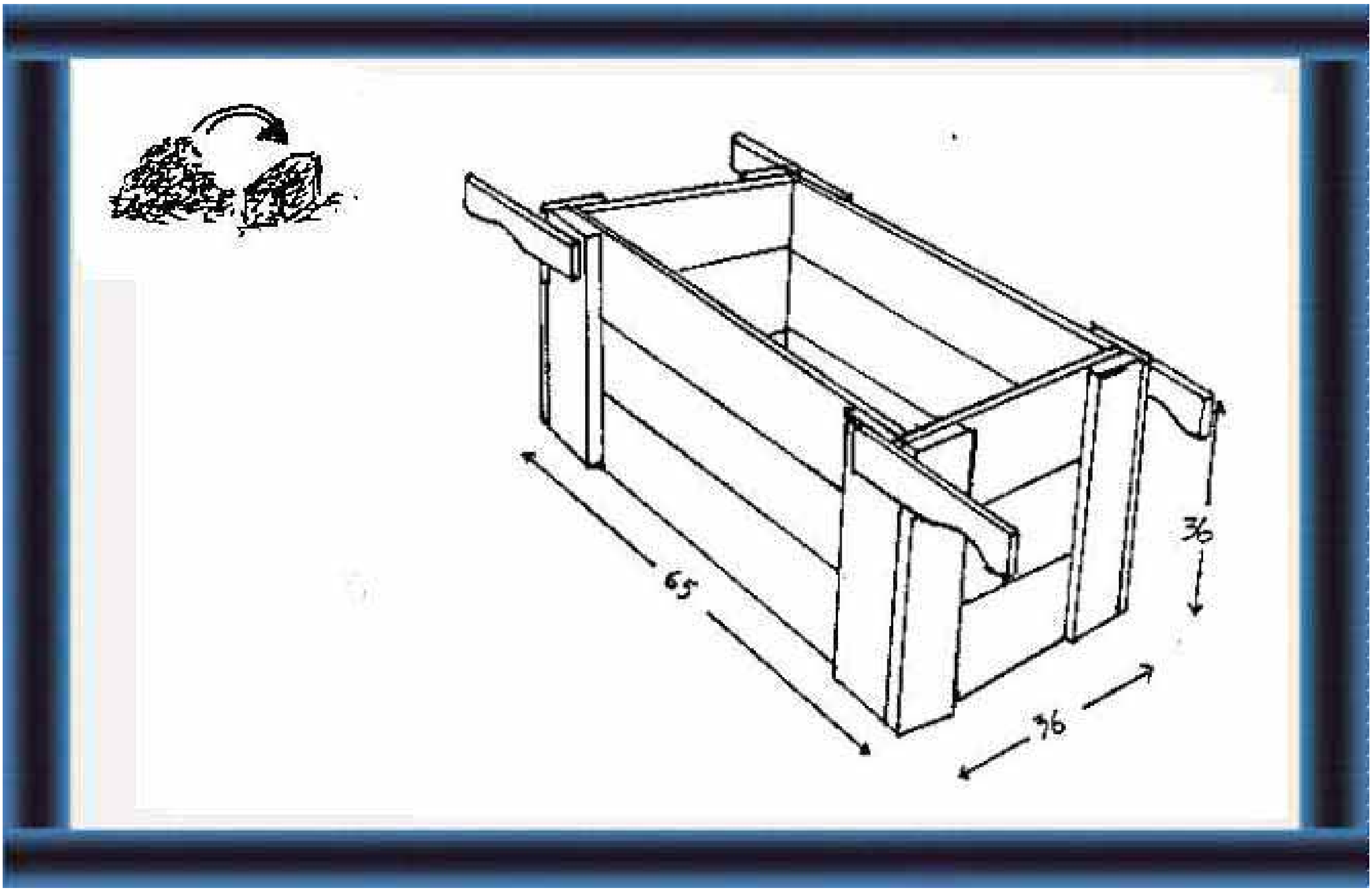


59

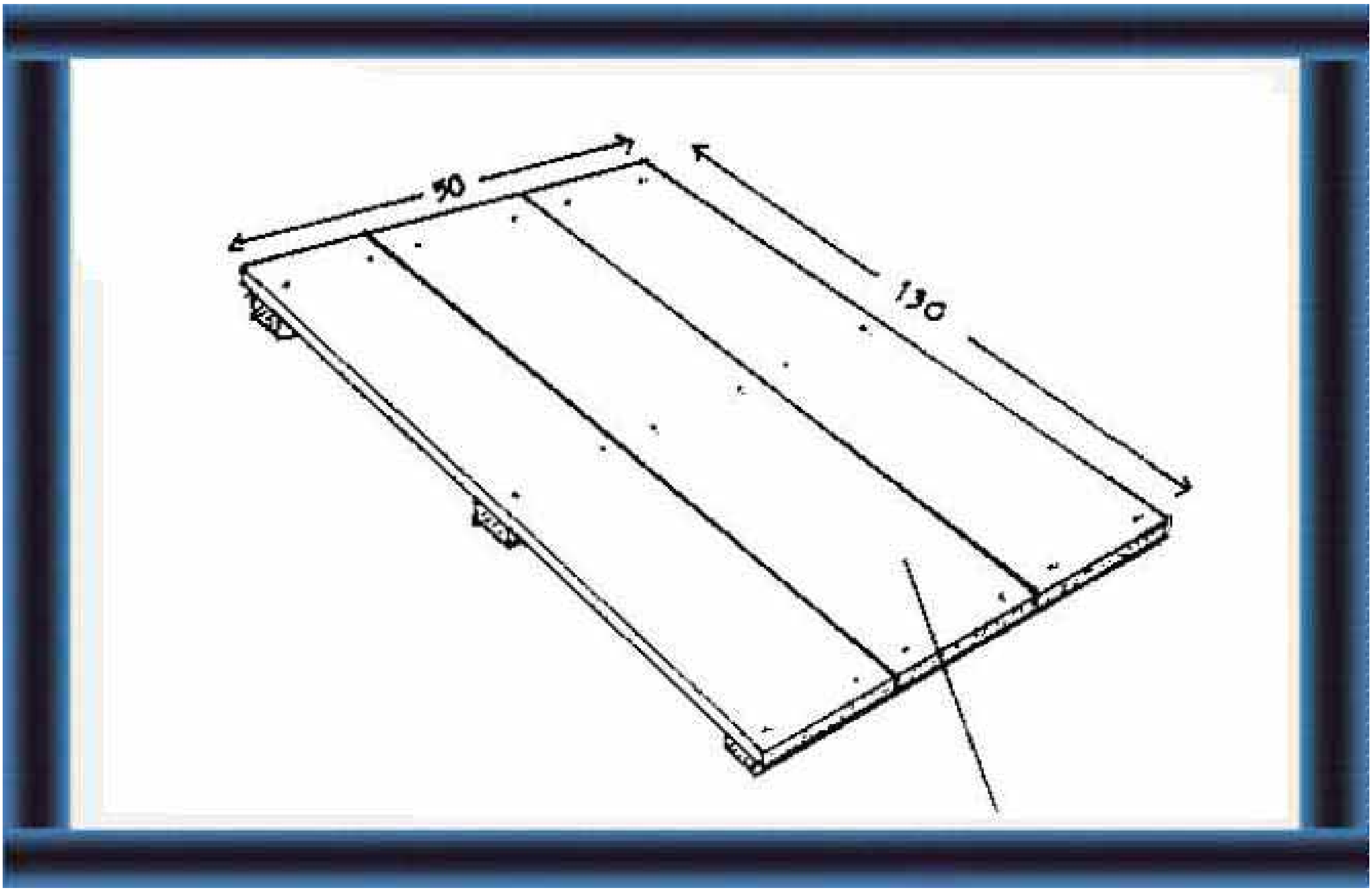
Corners: 8 pieces 36 x 15 x 2 cm

Handles: 2 pieces 105 x 8 x 2 cm

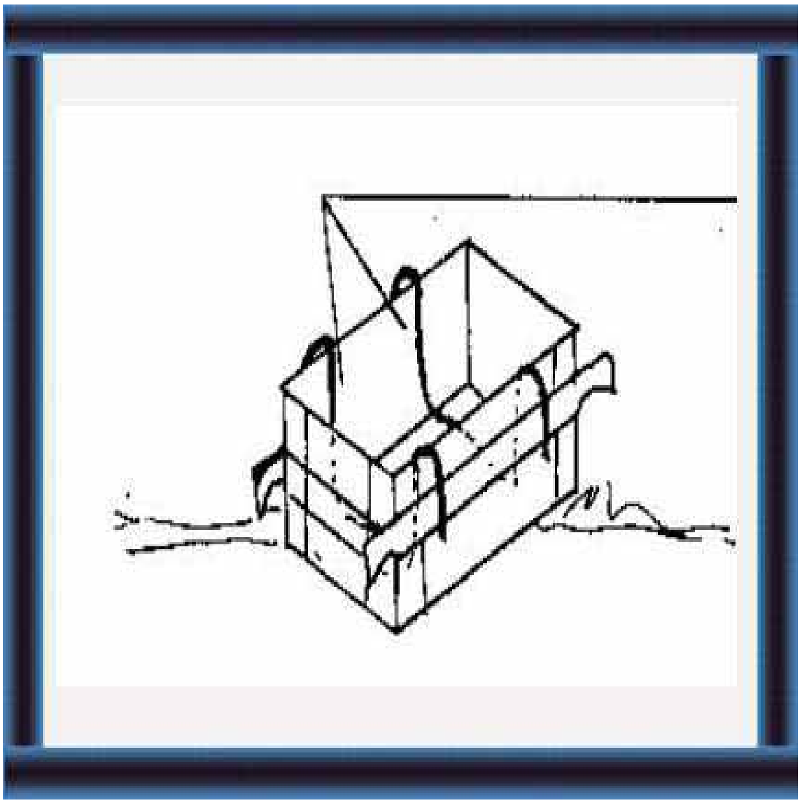
60



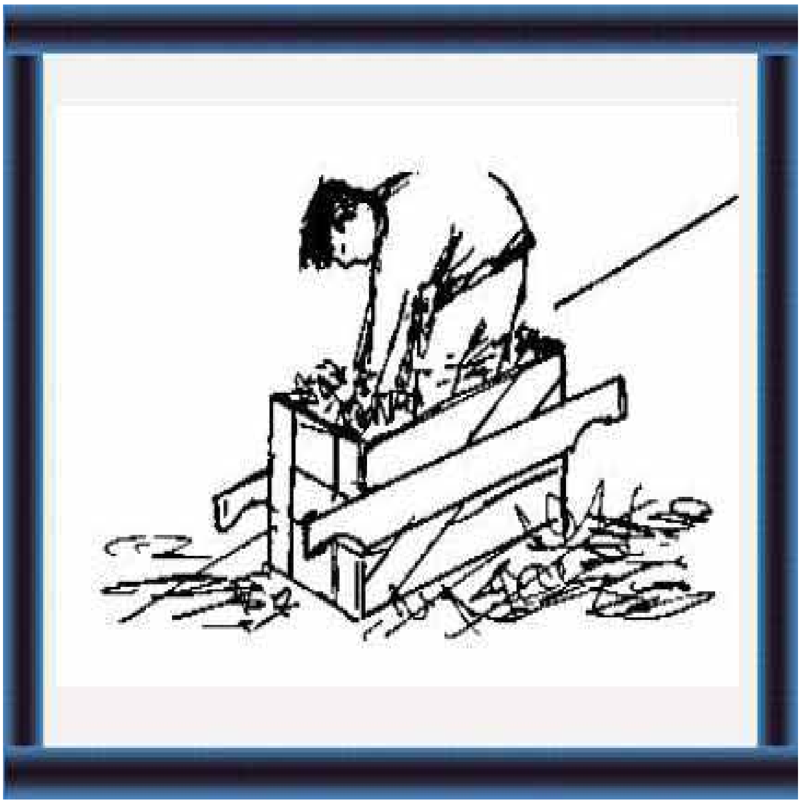
61 Make a **platform**. This gives an **even surface** when baling in the field.



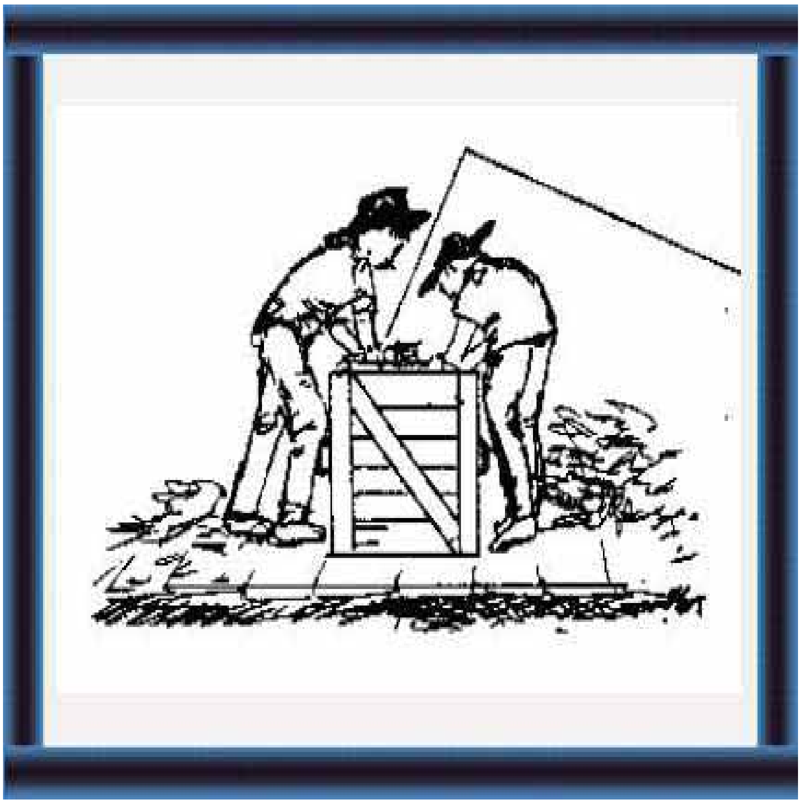
How do you use the baling box?



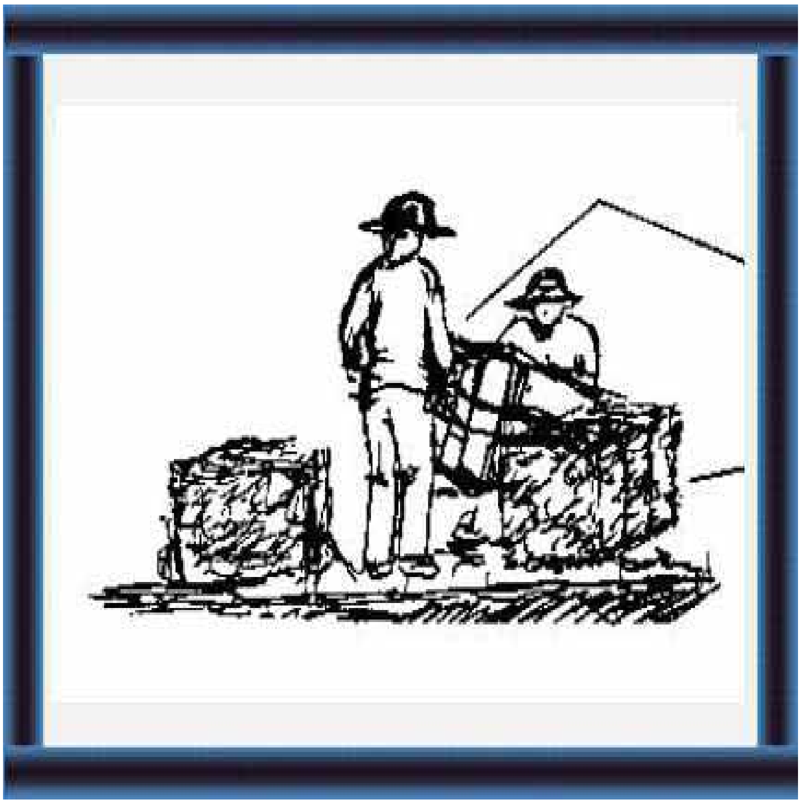
62 Put two **long** ropes **into the baling box**.



63 **Tread** the hay into the box.

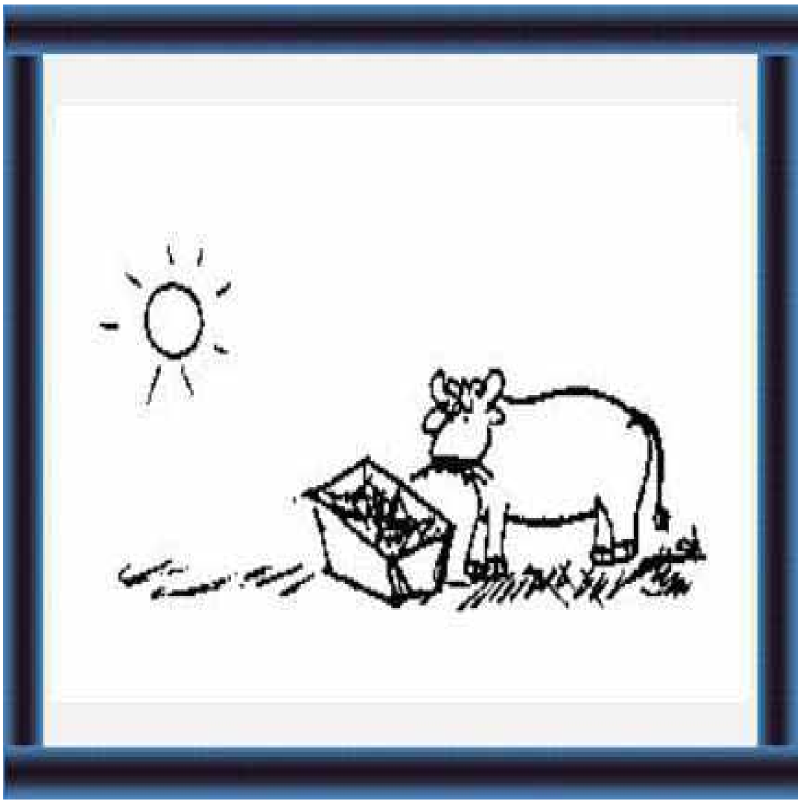


64 **Tie** the ropes very **tightly**.



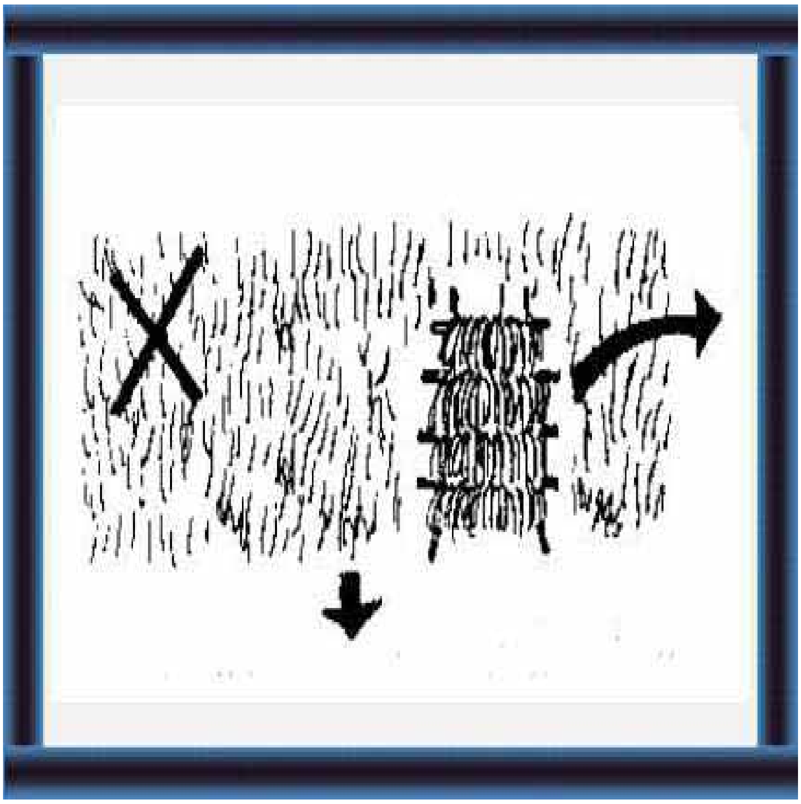
65 **Lift** the baling box, and **tip** the bale out.

Why should you store hay?

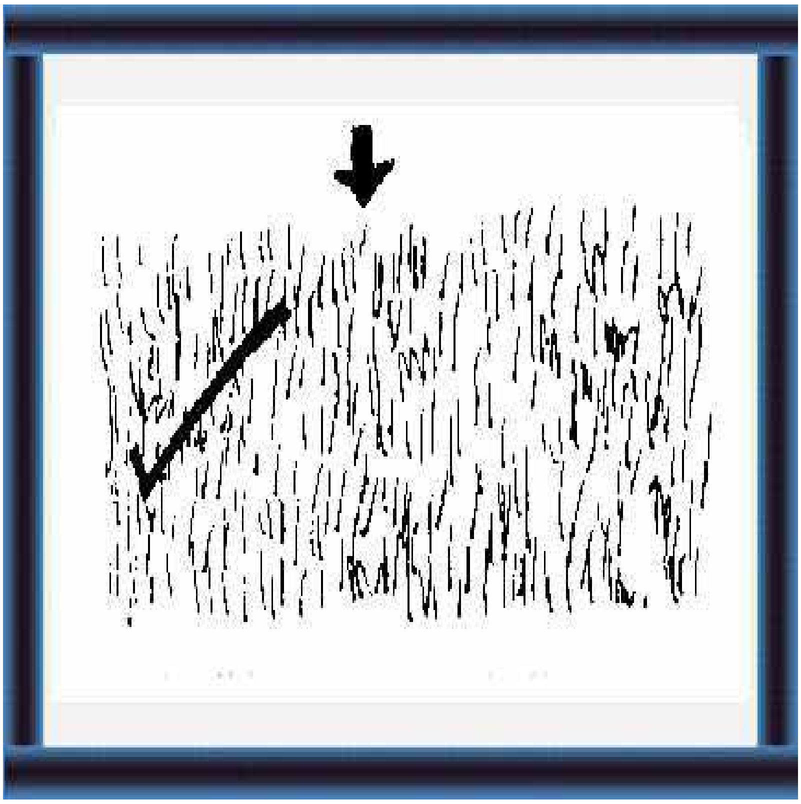


66 Hay is made from **crops grown** in the **wet** season but your calves and cattle **need high quality feed** for many months in the **dry season**.

You must **store** hay for the dry season. Then your animals can feed when grass cannot grow.



67 **How can you store hay?**

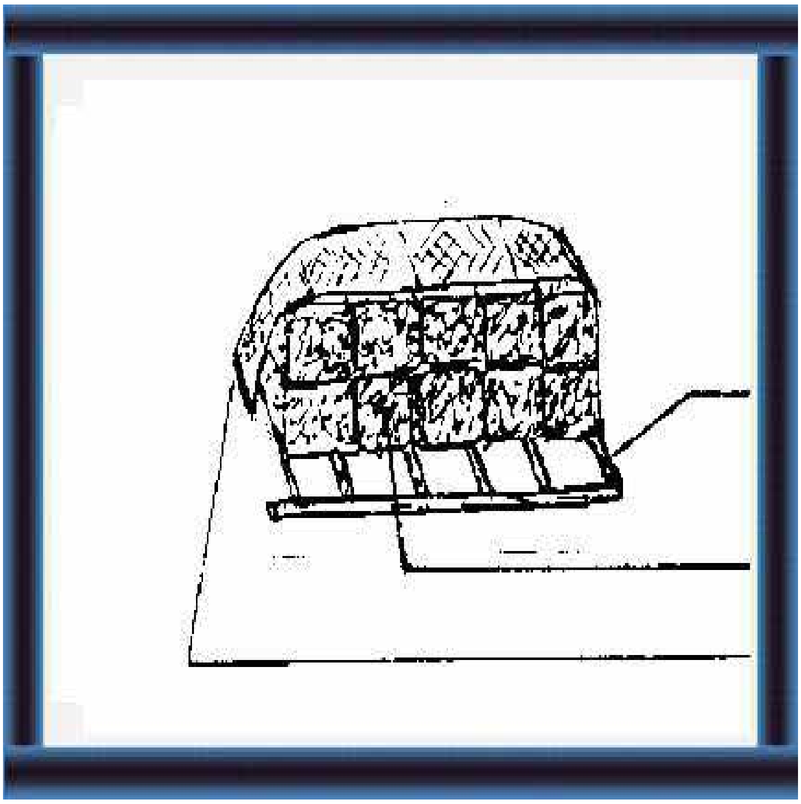


68 **When** the hay is **ready for storing**, **remove** it from the field.

More grass can grow where you put your hay racks in the field.

69 Store hay **close** to the **shed**.

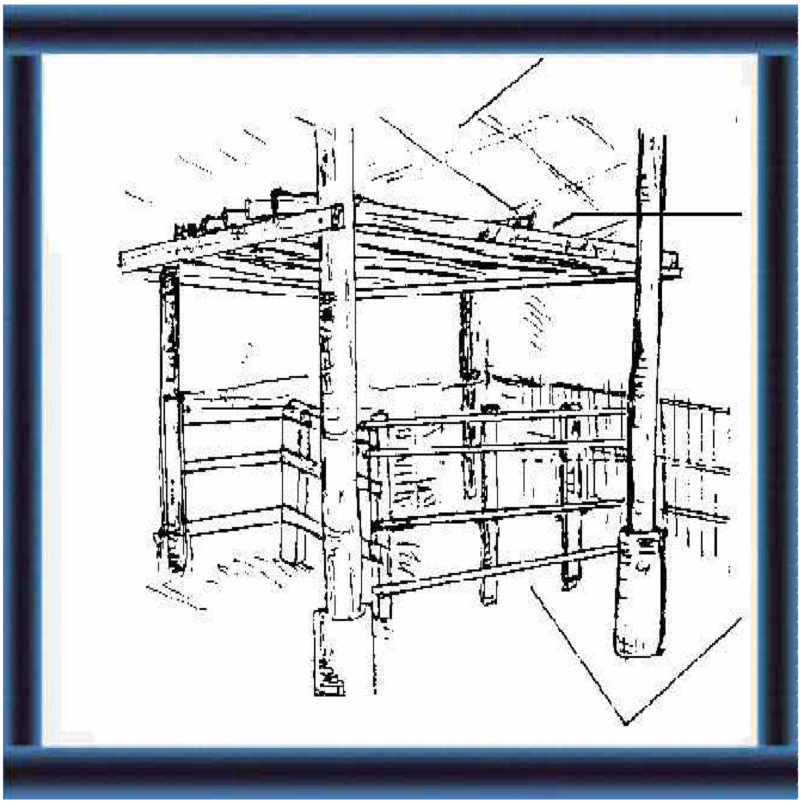
Then it is **easy** to feed your cattle.



70 If you have **no suitable storage site**, store hay on **slats:**
- **slats** to keep the hay **off the ground**
- **mats** or **plastic cover** to keep the hay **dry**
- bales of hay.

71 If you store hay for a **long time**, it has **lower feed value**.

Hay may also become **mouldy**.
Watch out for mould.
Do not feed mouldy hay to calves.



72 You can store hay under the roof of the cow shed and above the housing area for calves.

Storage platform

Calf pen

---

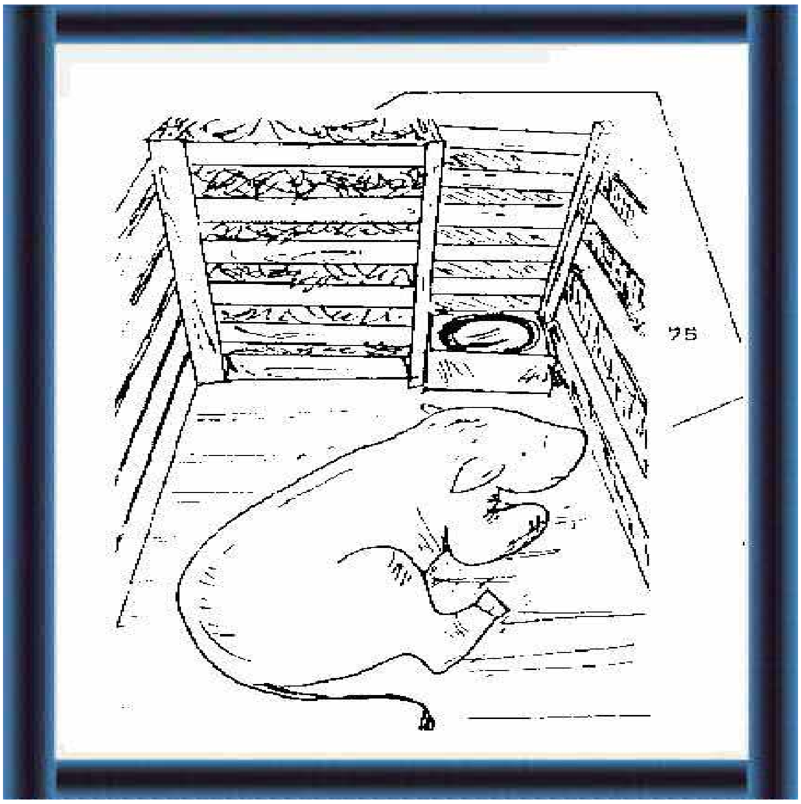
73 You can also **store hay** with **silage**.

The **roof shelters** hay and silage.

The **platform supports** the **hay** and helps **further drying**.

74 The pit gives room for forage to make silage.

How can you feed hay?

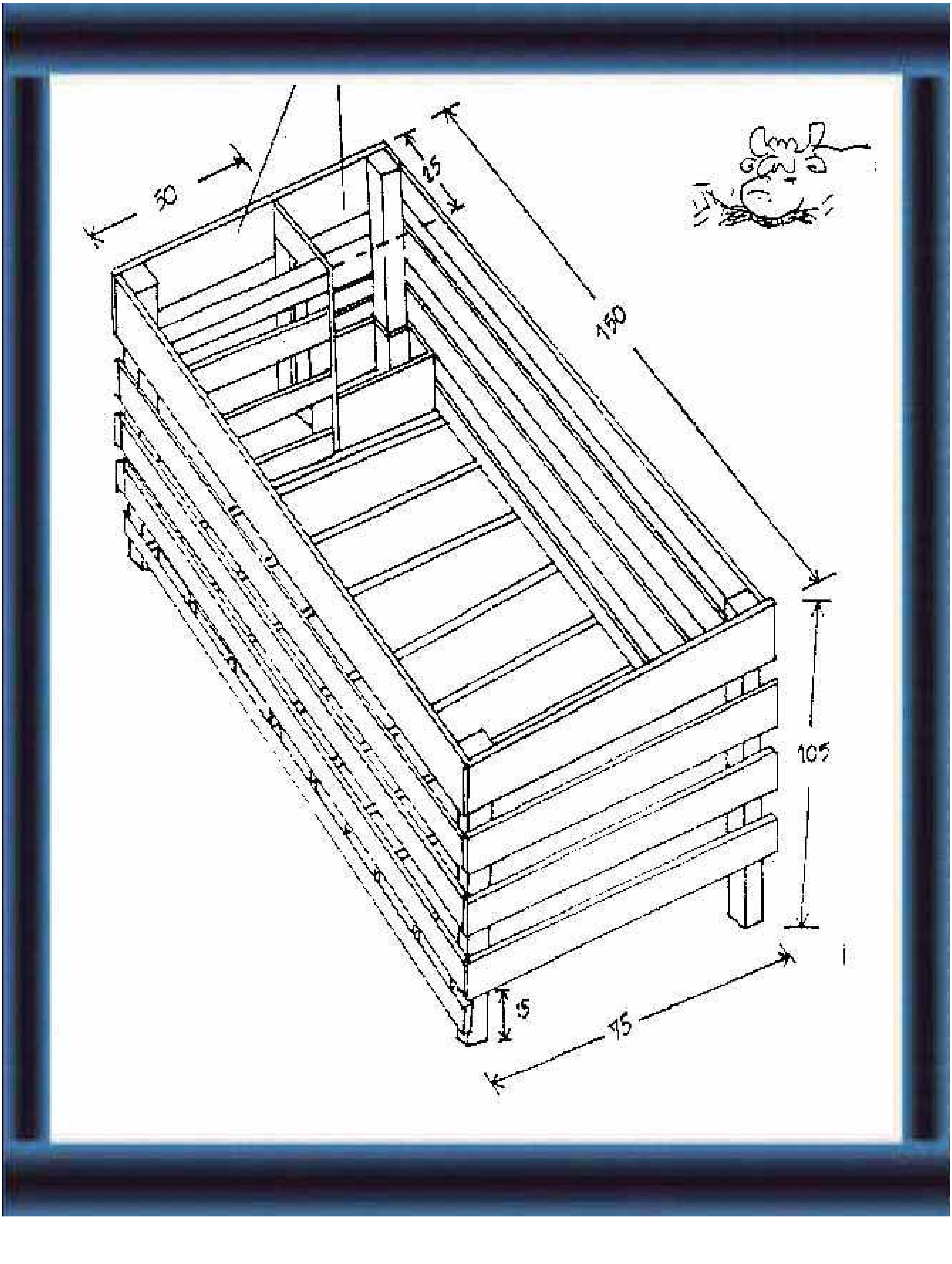


75 You can feed hay from hay racks in individual calf boxes

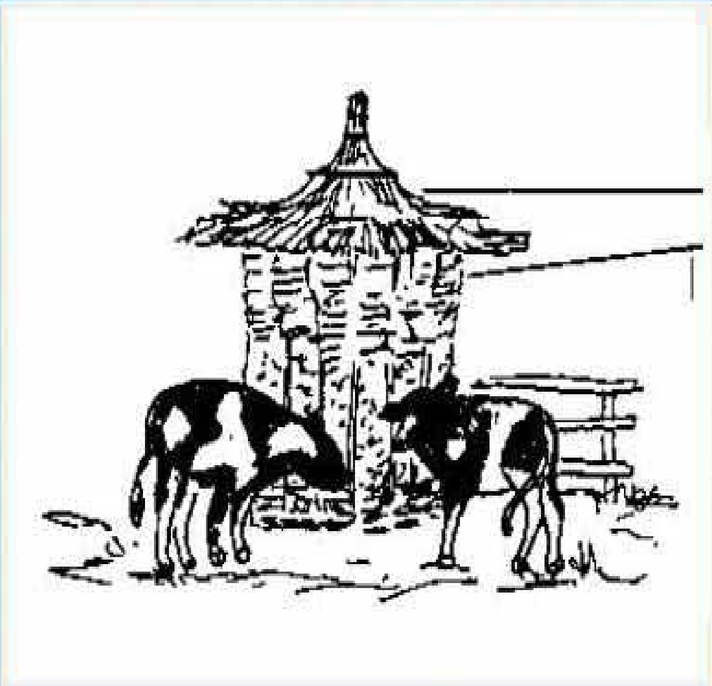
76 or from self feeders for calves in your exercise yard.

How can you make a hay rack?

77 Make your calf box like this (measurements in cm):
- with a rack for hay
- and a place for concentrates and water buckets.


30
25
150
105
15
75

How can you build a basket hay store and self feeder for the exercise yard?

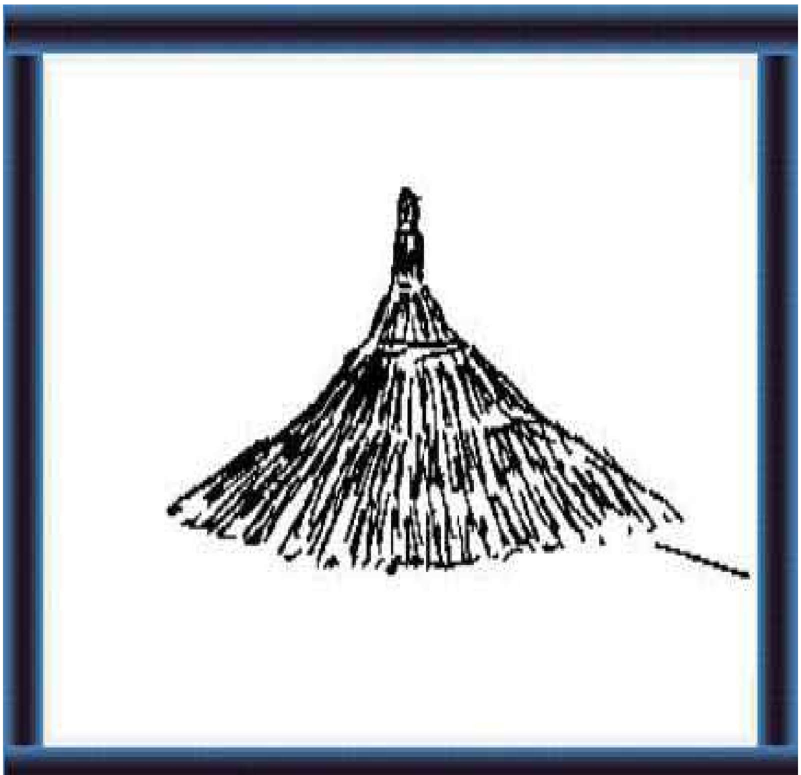


78 You need:
- grass for the roof
- sticks and branches for the sides.

Do not use nails or wire.

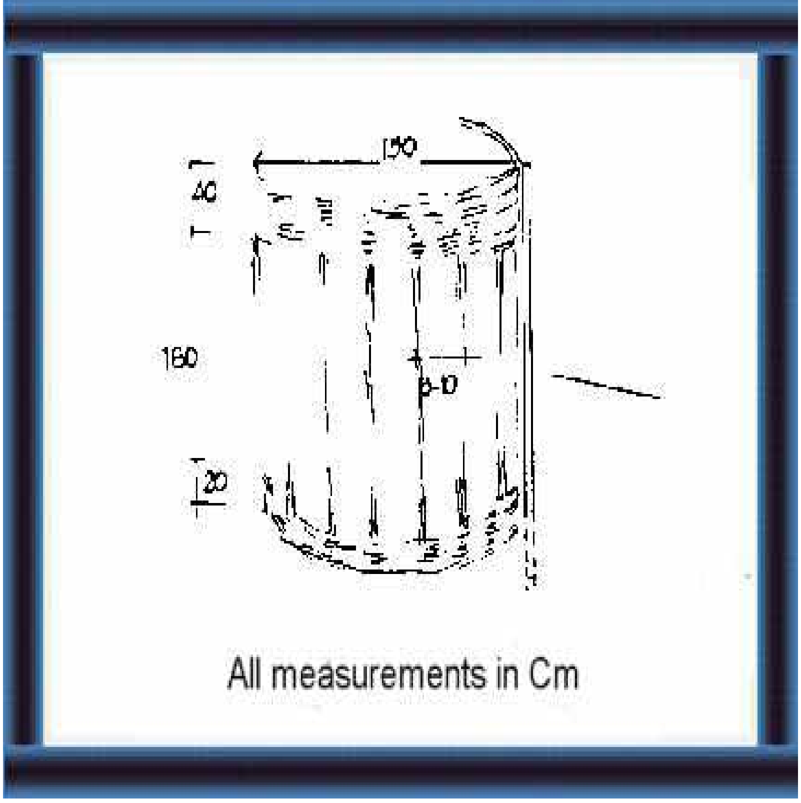
These may hurt cattle.

Use ropes to tie branches and sticks.



79 Make the roof from thatching grass.
You can lift the roof to add more hay.

Add poles to make the feeder stronger. A feeder of this size can hold up about 250 kg of hay.



What do you know about hay making?

Feeding good hay increases your milk production

1 Good hay is: (9-11)

- low in fibre
- rich in protein and nutrients.

2 Feed when you have no grass in the dry season. (12-15)

Making hay for feed requires planning and equipment

	Planning	Equipment	
Cutting Sickle -	1 When crop flowers 2 When weather dry	Sickle	(21-26)
Drying dry	1 Prepare equipment 2 Load and turn hay 3 Keep hay off ground/ 4 Choose a suitable rack (size, ease of making, weather)	Drying Racks Hurdle Heinz Fence Tripod	(27-31) (32-35) (36-37) (38-41) (42-43) (44-47)
Baling tipping)	1 For keeping leaves 2 For easy handling, transportation and rationing 3 Checking dryness 4 Making a baling box 5 Using a baling box (treading, tying,	Baling box	(48-52) (53-57) (58-61) (62-65)
Storing -	Keep hay dry for the dry season	Slats and cover Platform	(66-74)

Feeding	**1 Making a hay rack** **2 Making a haystore and self feeder** **3 Locating for easy feeding**	**Hay racks**	**(75-80)**

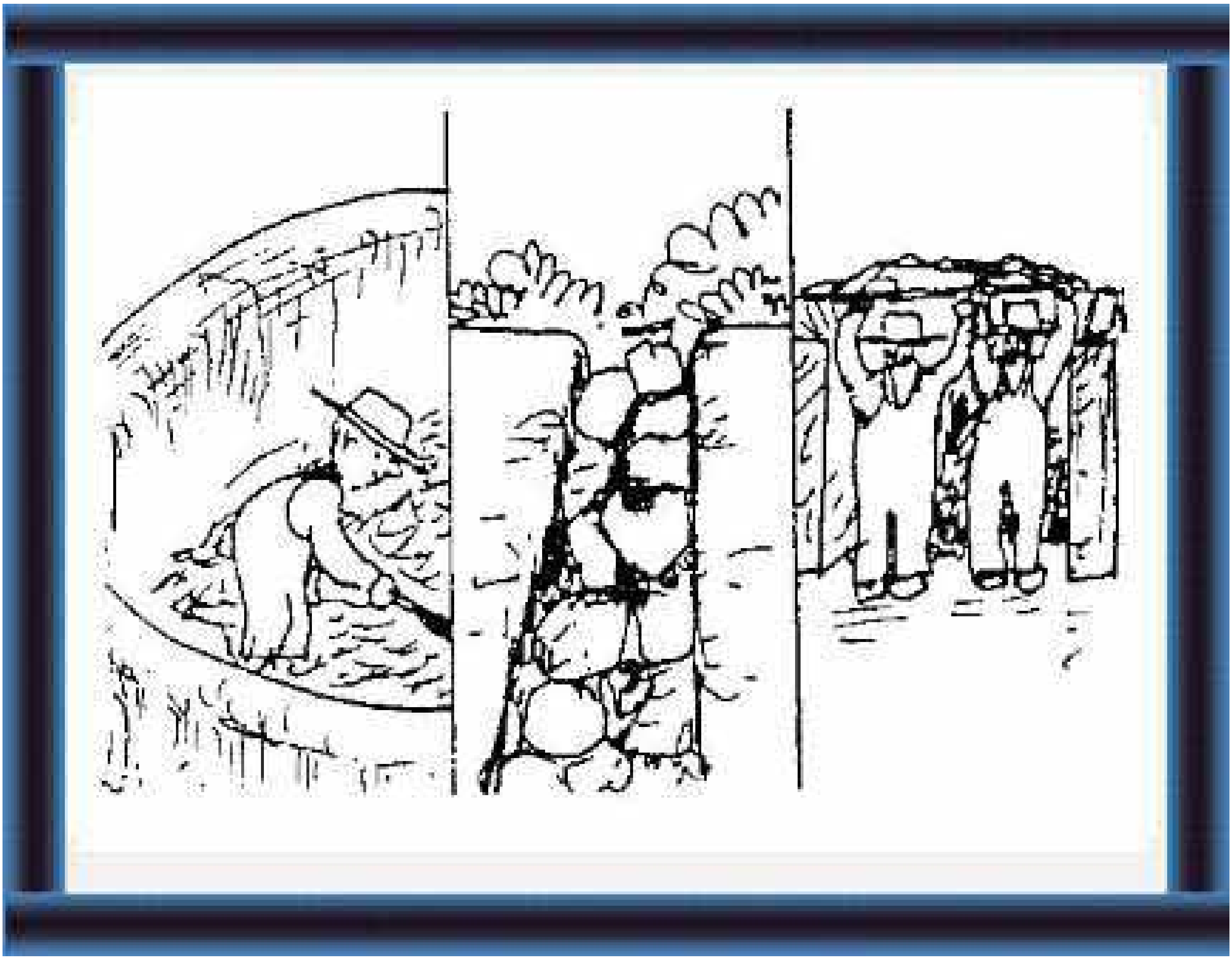
Small-Scale

Dairy Farming Manual

Volume 3

Husbandry Unit 5.4 - Part 1

SMALL SCALE SILAGE MAKING



Extension Materials

What should you know about silage making?

What is silage and why is silage important?(5-12)

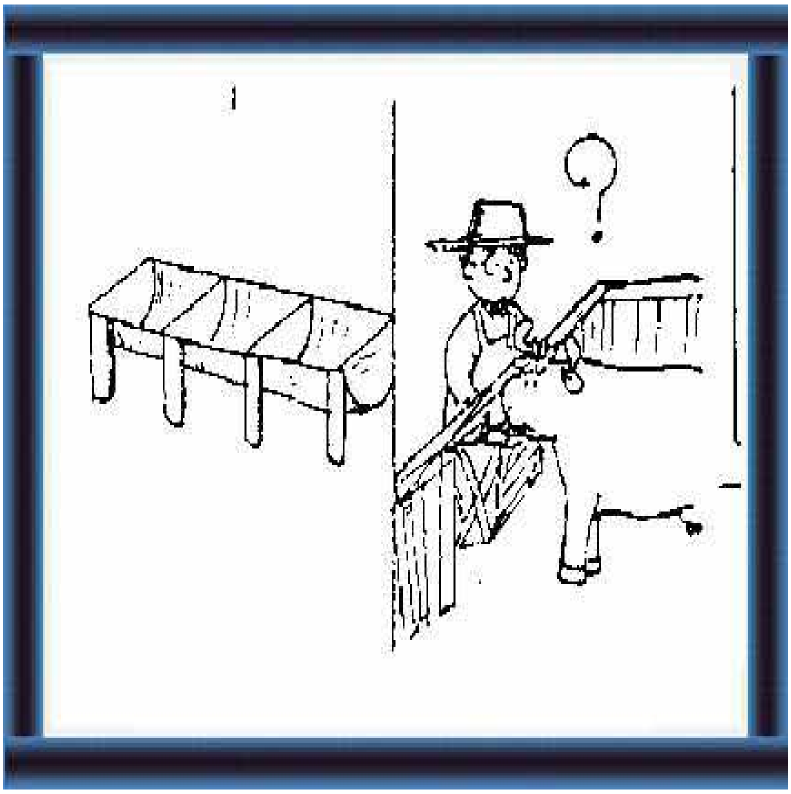
1 You should know:
- the **feed value** of silage
- the **importance** of **storing** and **feeding** silage.

How can you make a "silo"?(13-56)

2 You should know:
- the **types of silos**
- **how to make** a suitable silo for your farm.

How do you prepare the crop and handle silage? (57-82)

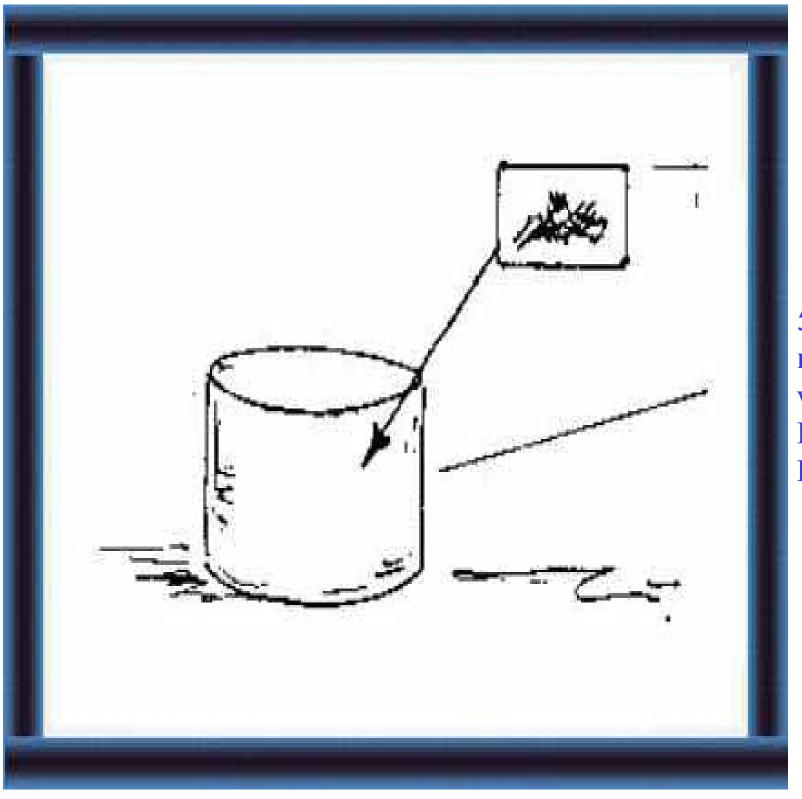
3 You should know how to:
- **prepare** your **crop** and **fill** your **silo**
- **seal** and **drain** your **silo**
- **remove silage**.



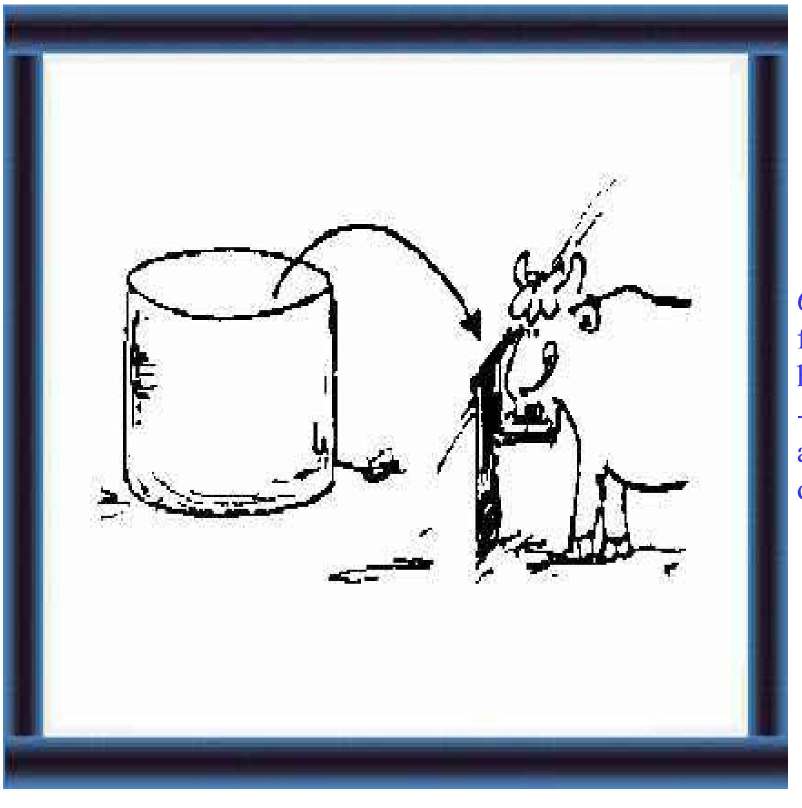
How do you feed silage? (83-87)

4 You should know how to:
- make a **feeder** for your silage
- **find** the **feeding value**.

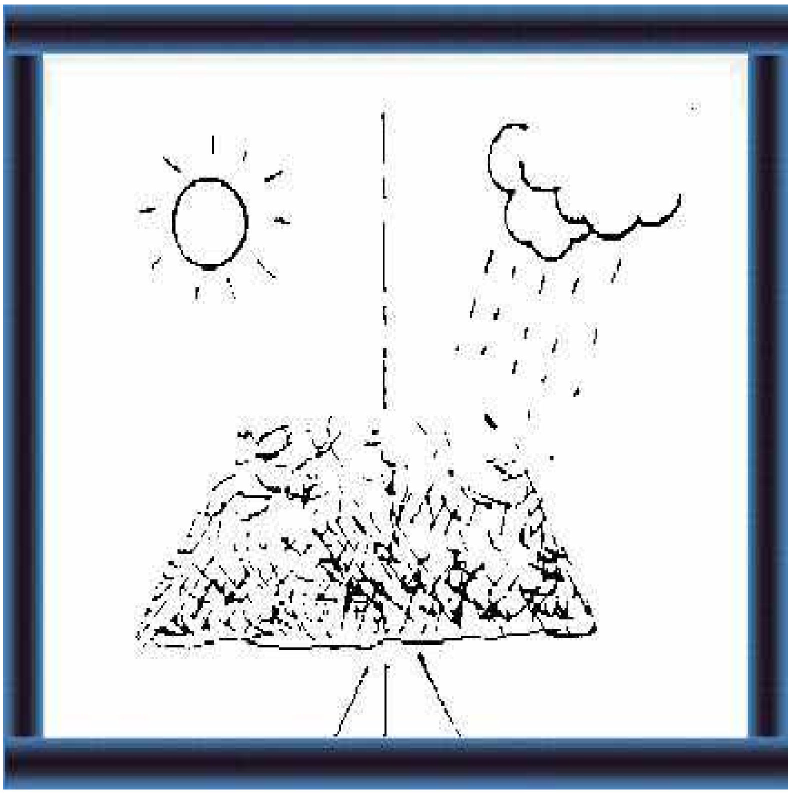
What is silage?



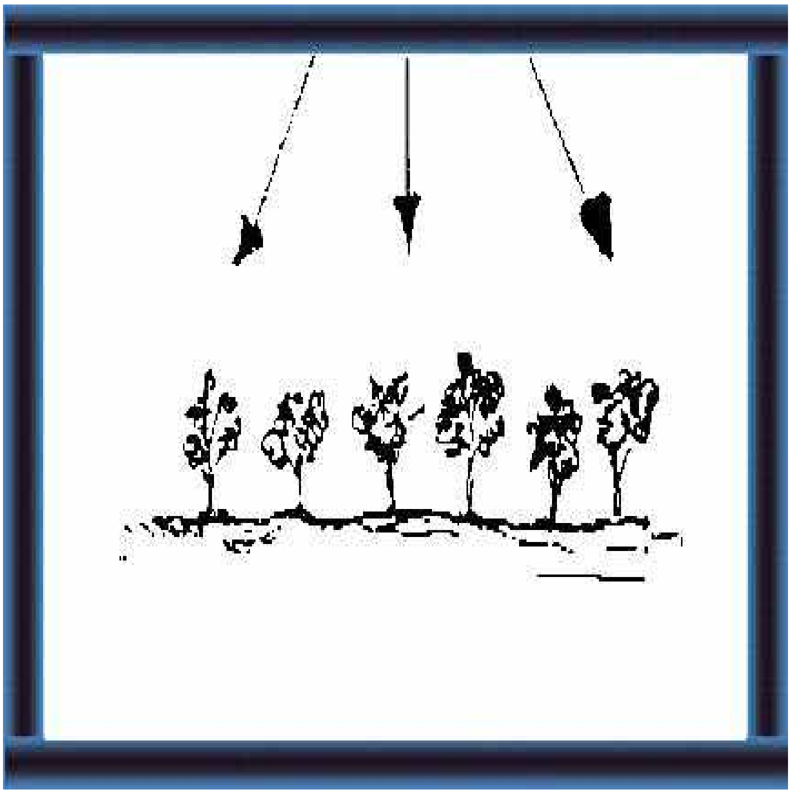
5 Silage is **cut plant material sealed** in a **silo** without air and water.
Rainy Season
Dry season



6 You can **store** the silage for **many months** and still have **good animal feed** - up to **85%** of the **energy** and **protein** value of the original crop.



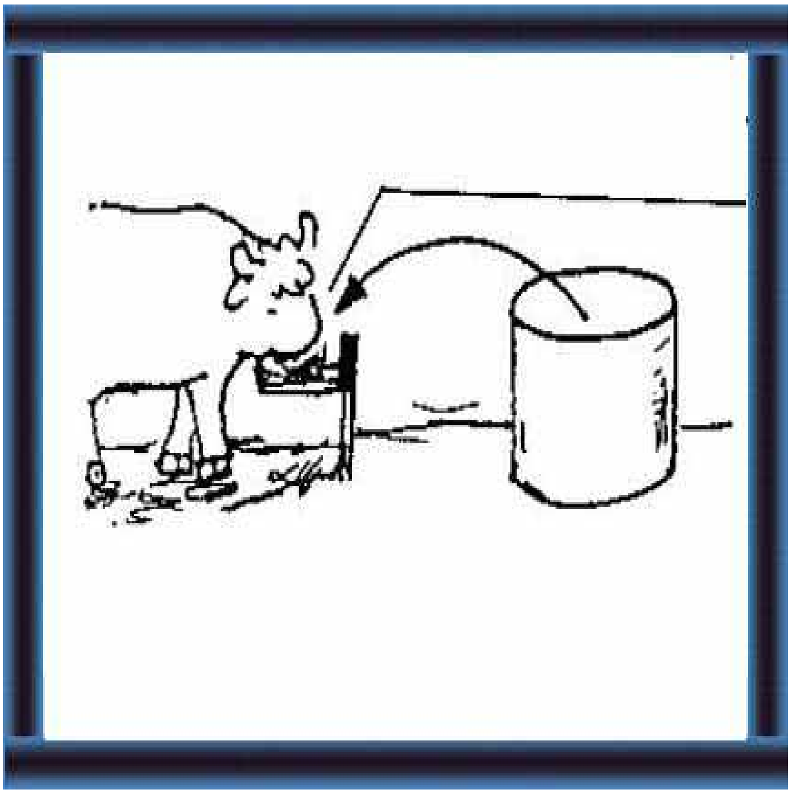
7 If you store the cut plant material with air and water



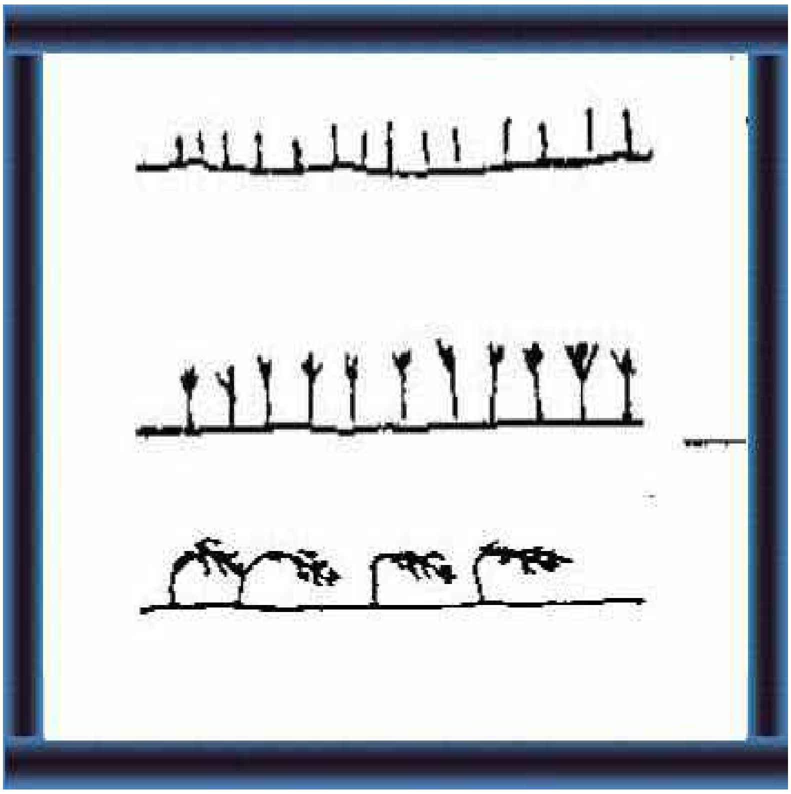
8 it becomes **rotten material/ compost**. You can use it for **fertilizer** but **not** for animal **feed**.

Why make silage?

9 You can store **extra feed** as silage

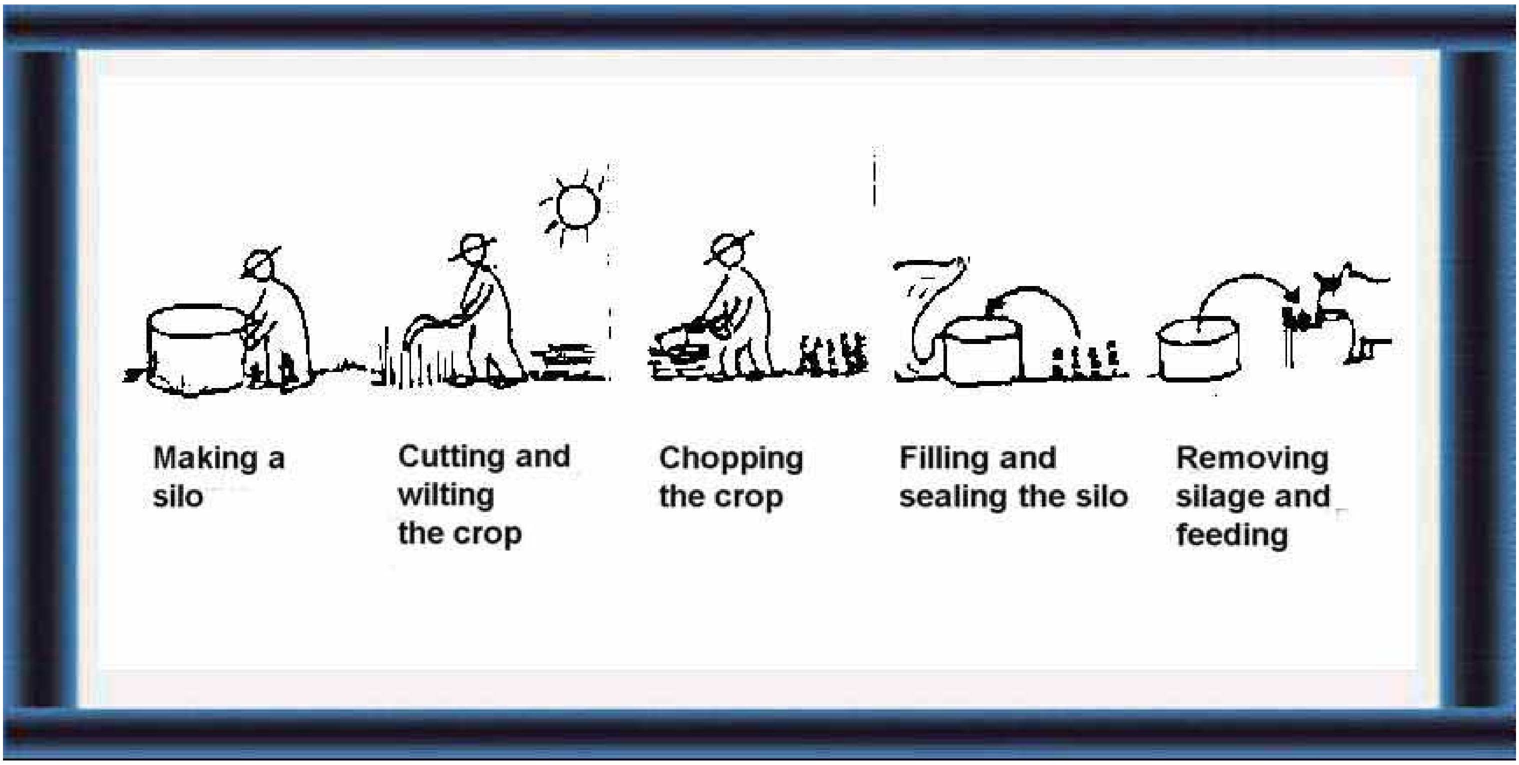


10 and use it as **animal feed** when **plants** are **not growing**.



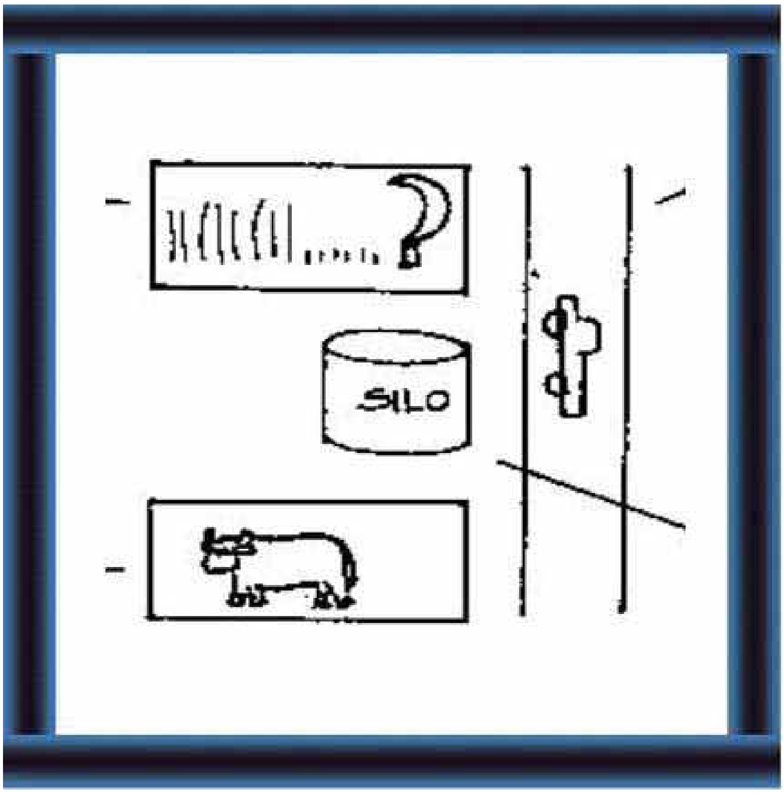
11 You can harvest your crops when they have highest feed value and store them for use throughout the year.

12 What are the steps in making silage?



Making a silo.

Where is a good place for the silo?



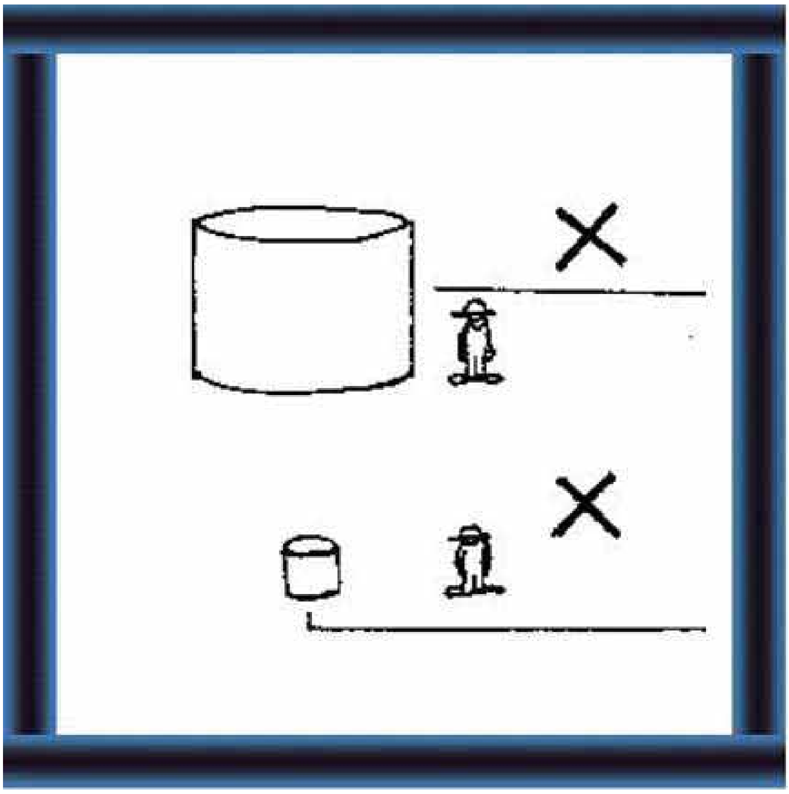
13

Near to where the crops are cut - short distance from the field to the silo.

Near to the road - you may want to transport or sell your silage.

Near to where the animals feed - short distance from silo to feeding animals.

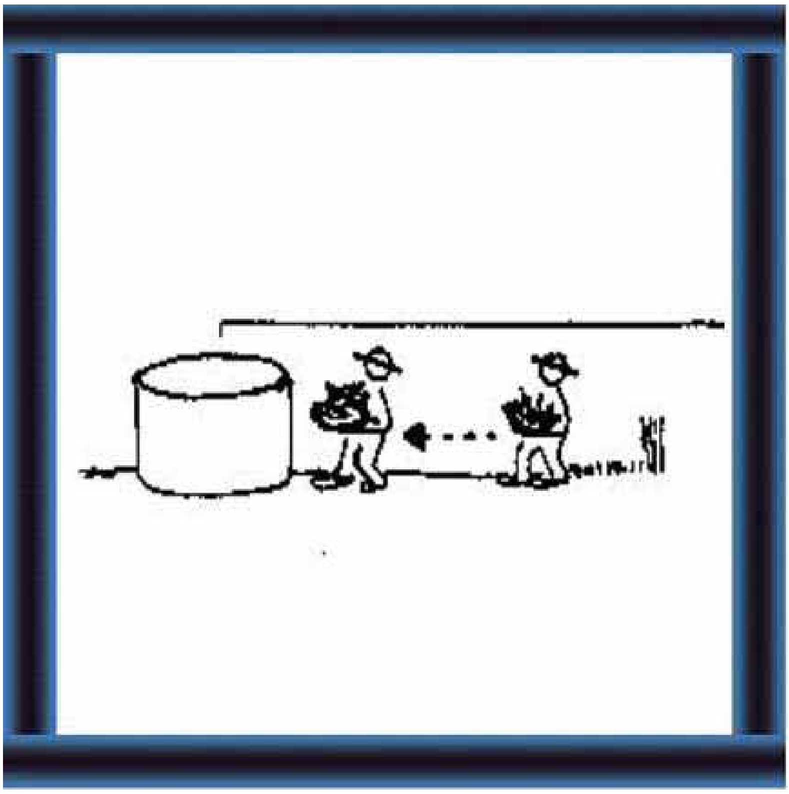
No water - in a dry area which is easy to drain.



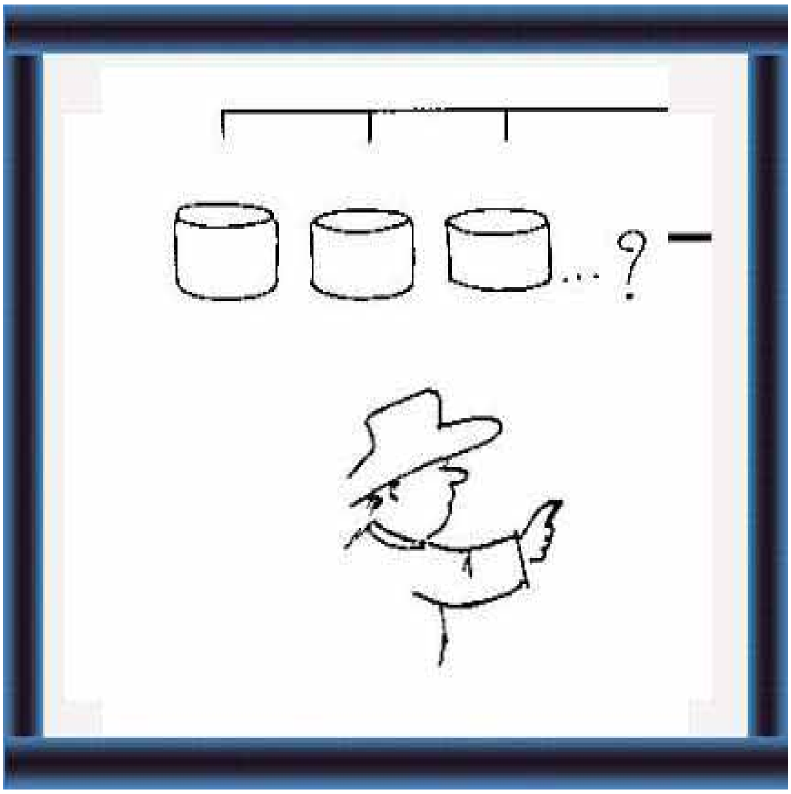
What is important in making a silo?

Right size

14 Big silos cost more. Very small silos have a lot of waste.



15 The smallest silos should have
4-5 m^3 of silage.
You need to cut the plant, carry
it and fill the silo in one day.



16 You need enough silage to feed your animals throughout the dry season.
Make more small silos not one big silo.

IMPORTANT: How many animals do you have?

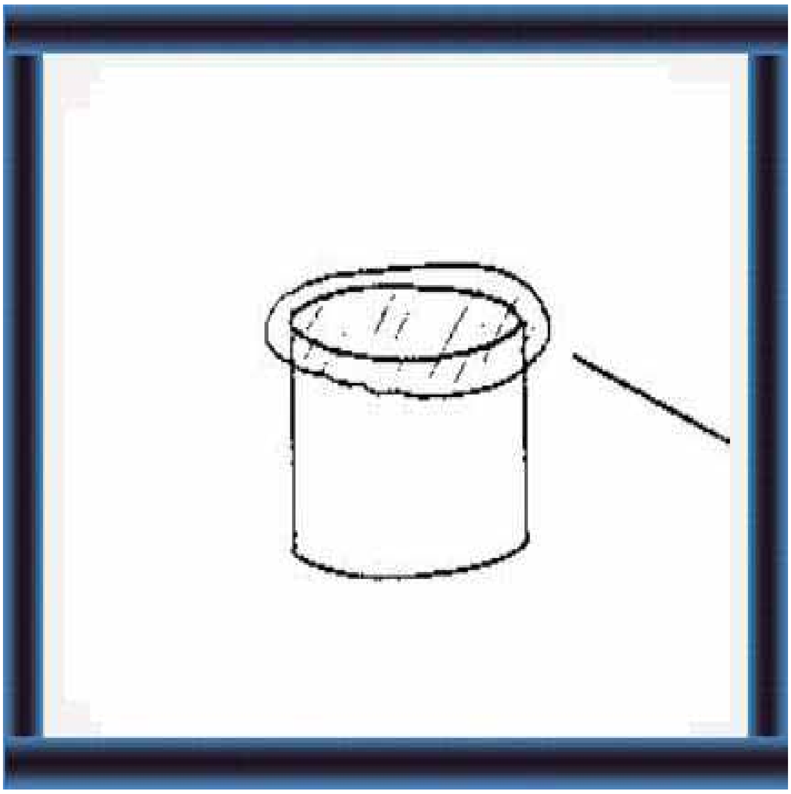
How much feed does each animal need?

How much spare crop do you have for silage?

Strength

17 You must compact the silage to remove air.

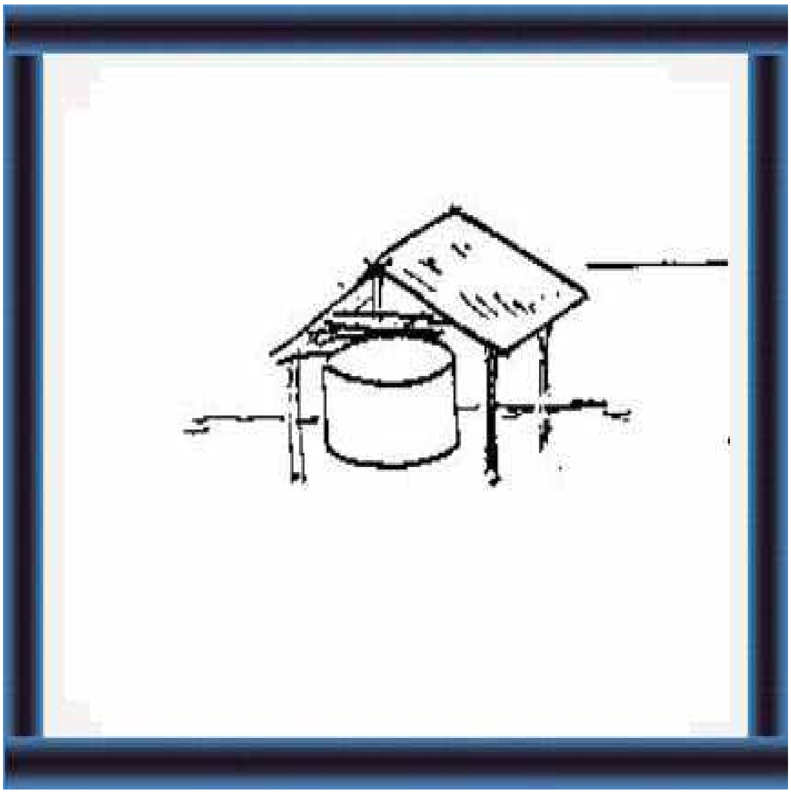
The silo must be strong enough for this.



No air

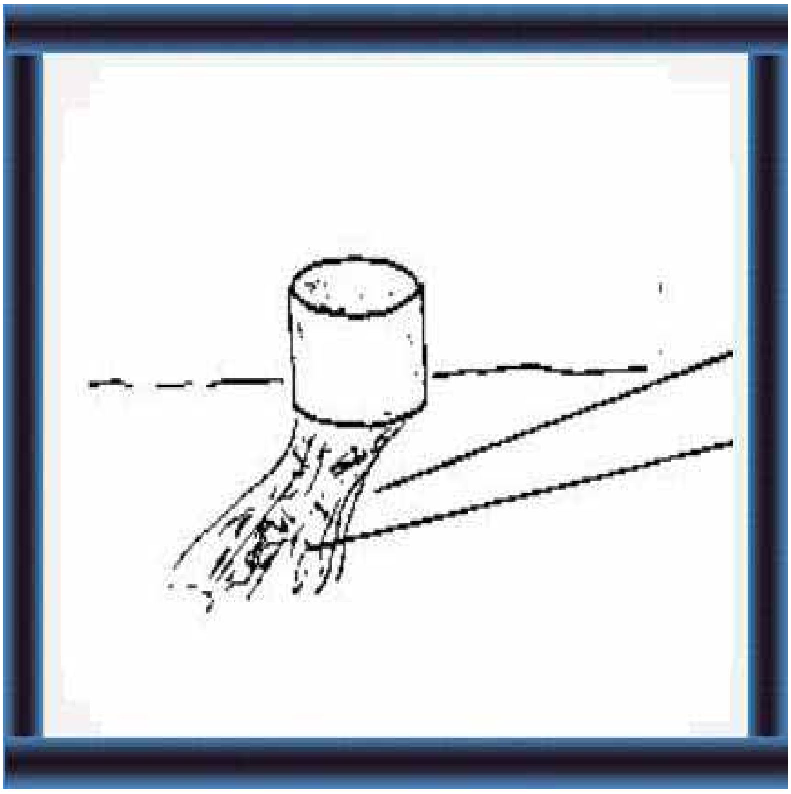
18 Air in silage causes problems:
- loss of energy
- increase in temperature
- growth of fungi.

Seal the top of the silo to keep air out, replace the seal quickly after removing silage.



No water/sun

19 Make a roof to protect silage from rain and sun.



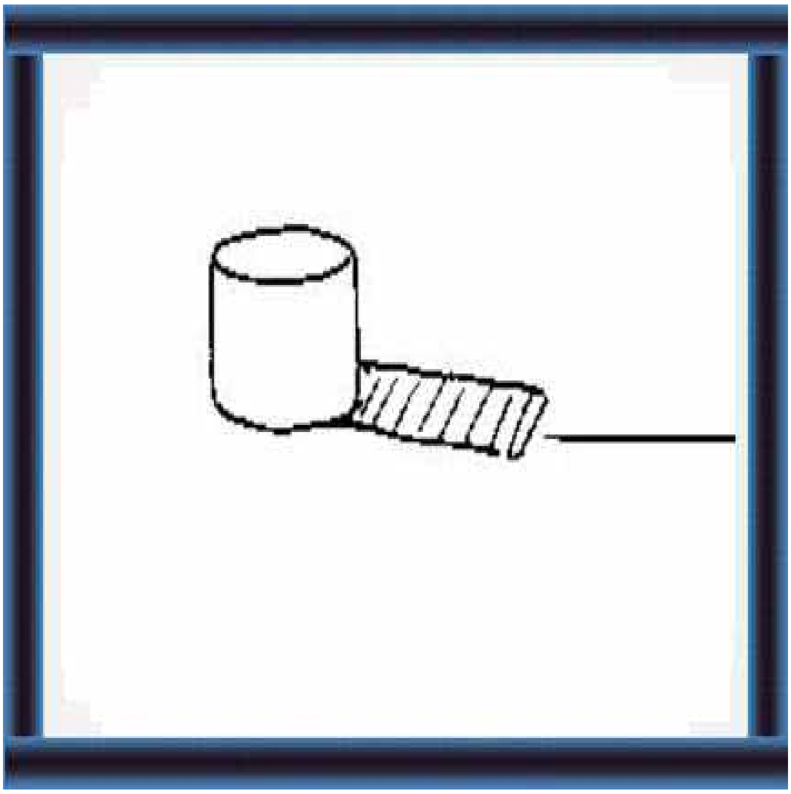
Drainage

20 Silage produces a lot of effluent.

Make drains on each side of the silo floor to remove waste.

Fill the drains with stones and rocks.

Make sure the drains do not go near drinking water.



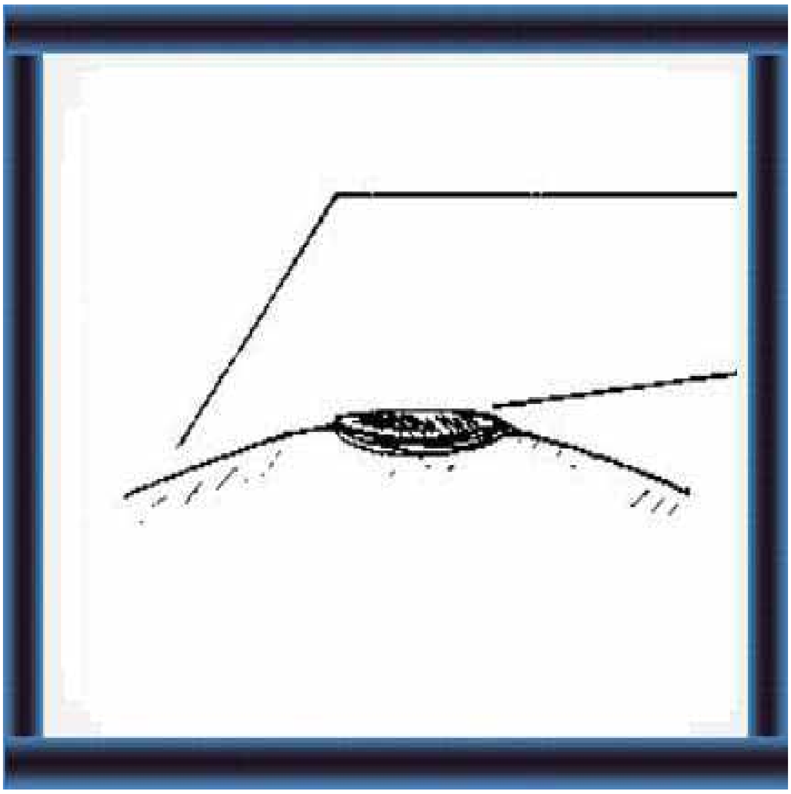
Base

21 If your silo is large, make a base for unloading equipment.

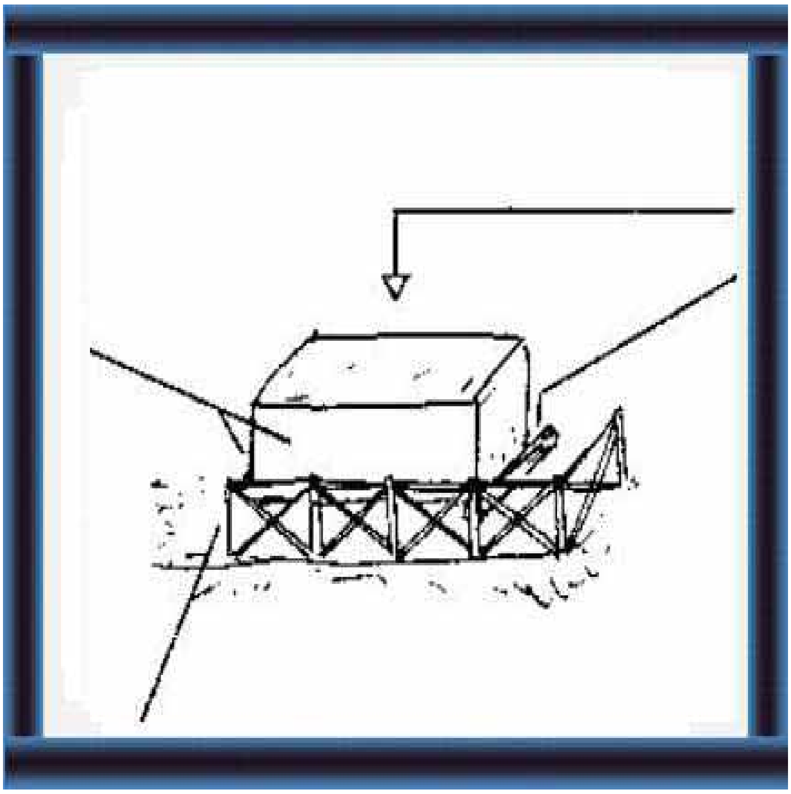
Types of silo

How can you make a stack silo?

22 Choose a site with good drainage and firm soil



base.
If possible, lay a concrete floor.



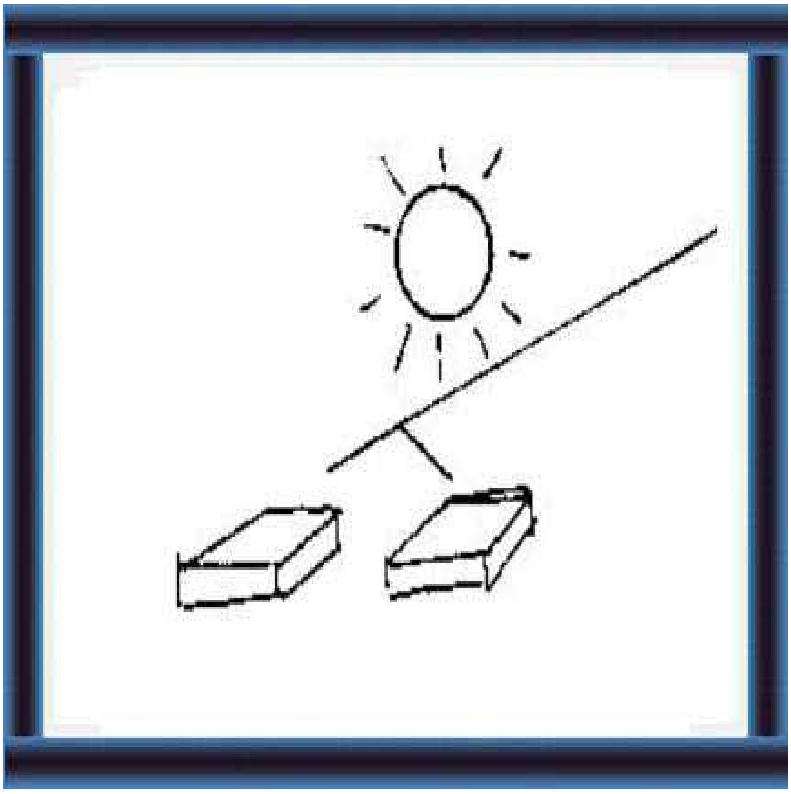
23 Stack the cut crop carefully.
Make it high at the sides and the ends.

Compact the stack.
Cover the stack with plastic sheets.
Fence the stack so that cattle cannot step on the silage.

Advantages	Disadvantages
1 Low cost.	1 Lot of waste at sides and ends.
2 Easy to move.	2 Difficult to roll the stack to check for high temperatures.

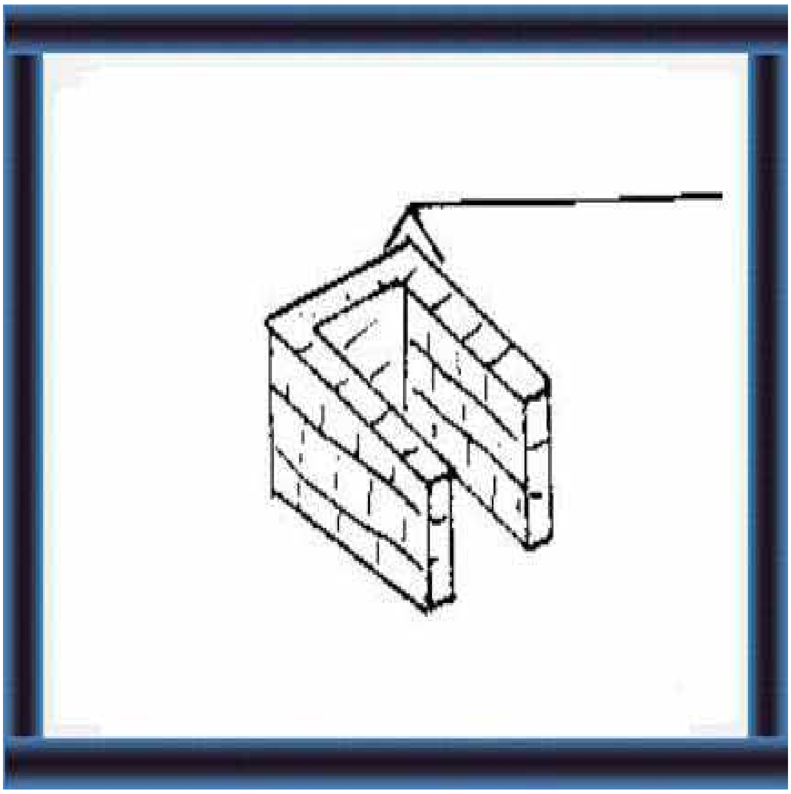
Material	Labour	Manhours
1 Earth bricks	1 Brick laying	90
2 Cement (12 bags)	2 Make walls & concrete	32
3 Sand (3 m^3)	3 Dig drains & fill trenches with stones	8
4 Wire-mesh (34 m) & staples (.8 kg)		
5 Broken stones for drainage (1.6 m^3)		
	Total man/hrs:	**130**

How can you make a walled clamp silo?

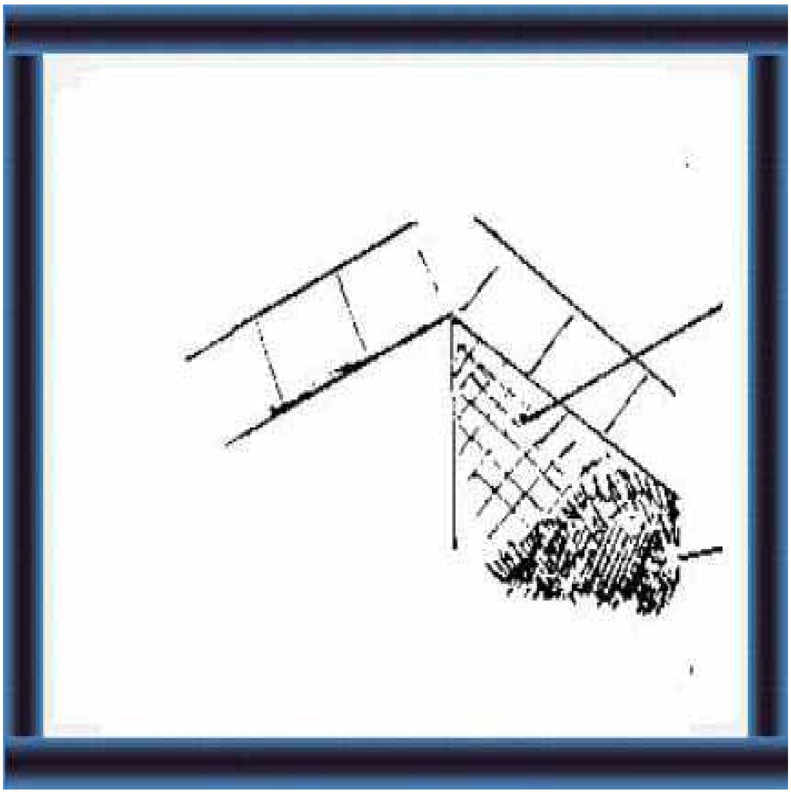


24 Make earth into bricks and bake them hard in the sun.

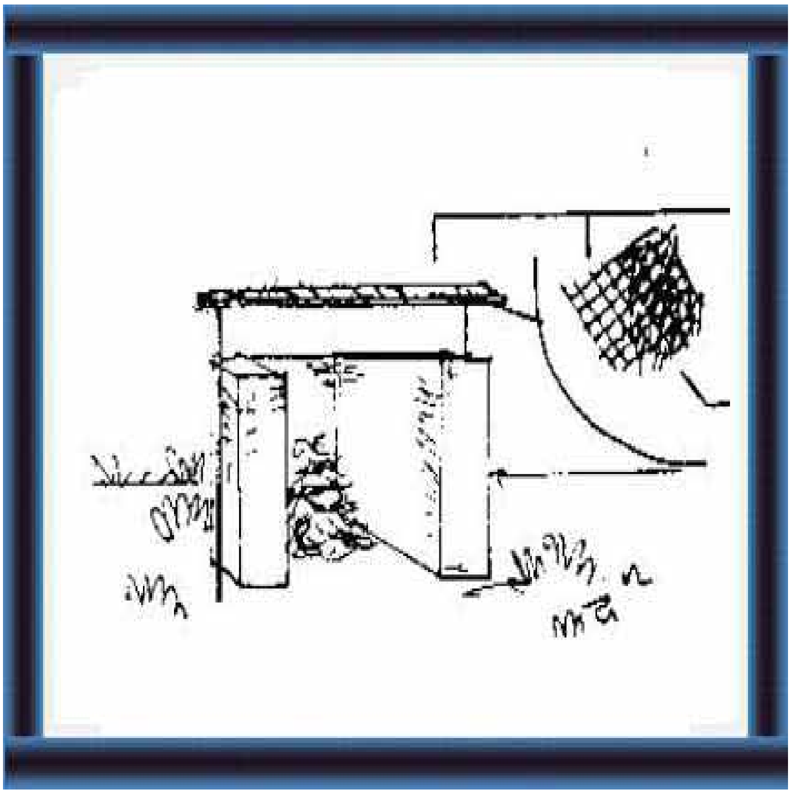
Cover the wire-mesh with a layer of concrete.



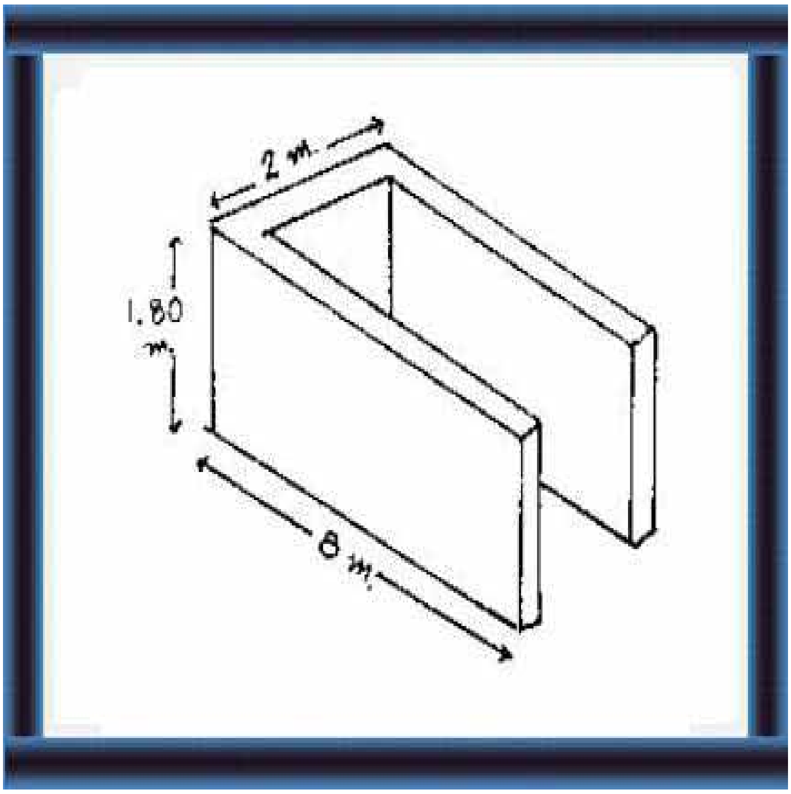
25 Build the walls of the silo from the bricks.



26 Put wire-mesh on the inside of the walls.



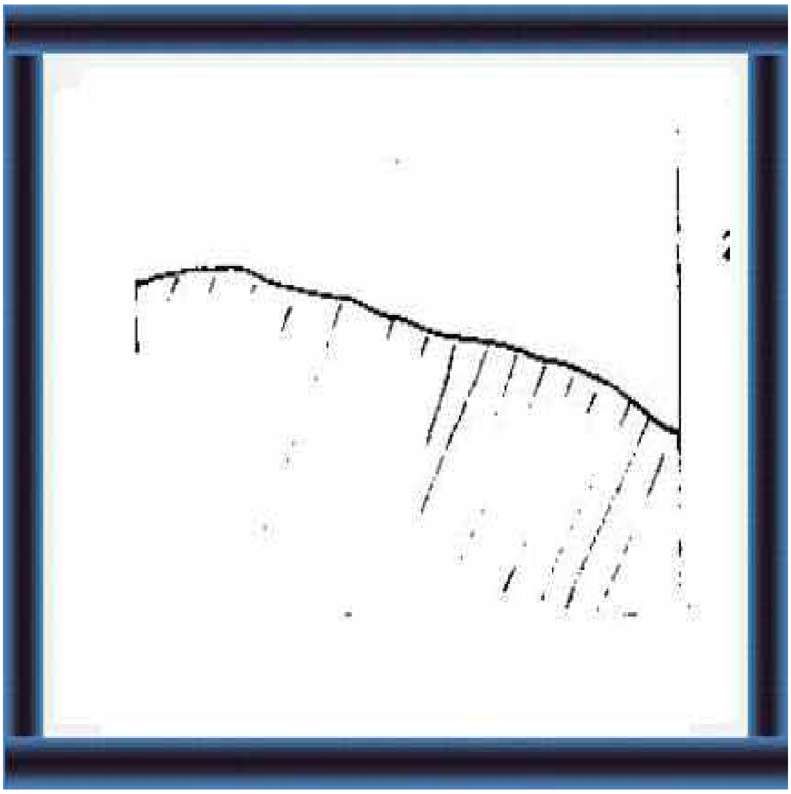
27 Make a roof out of wire-mesh and cover with a thin layer of straw.



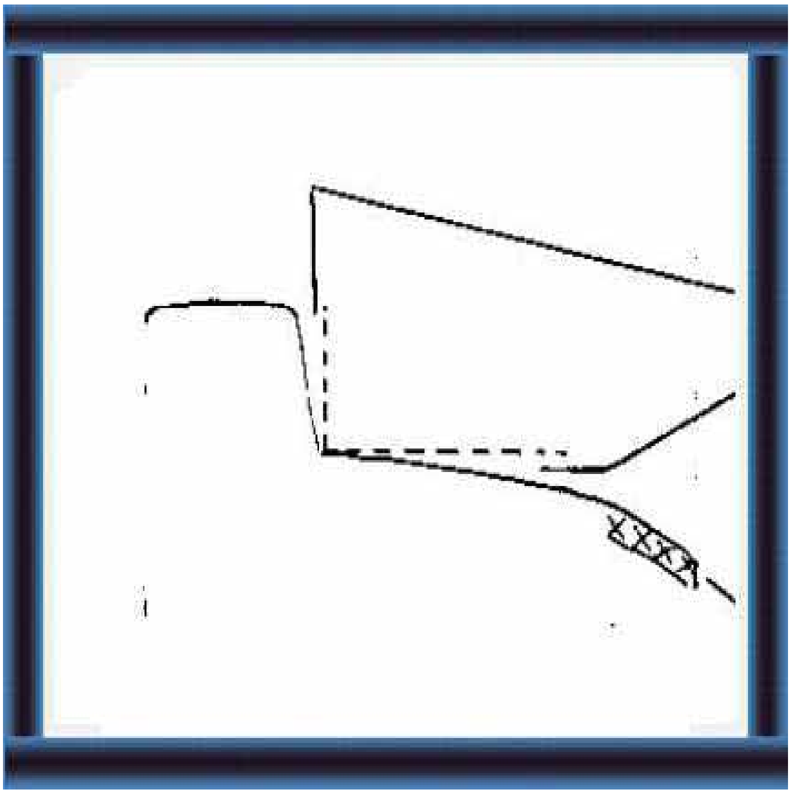
28 The silo has a capacity of about 35 m^3 (11,000 kg).
This is enough to feed 5 milking cows for 90 days.

Note:
1 Other materials for walls: metal or wood e.g. railway sleepers.
2 Silage produces acids. Treat materials with asphalt to protect them.

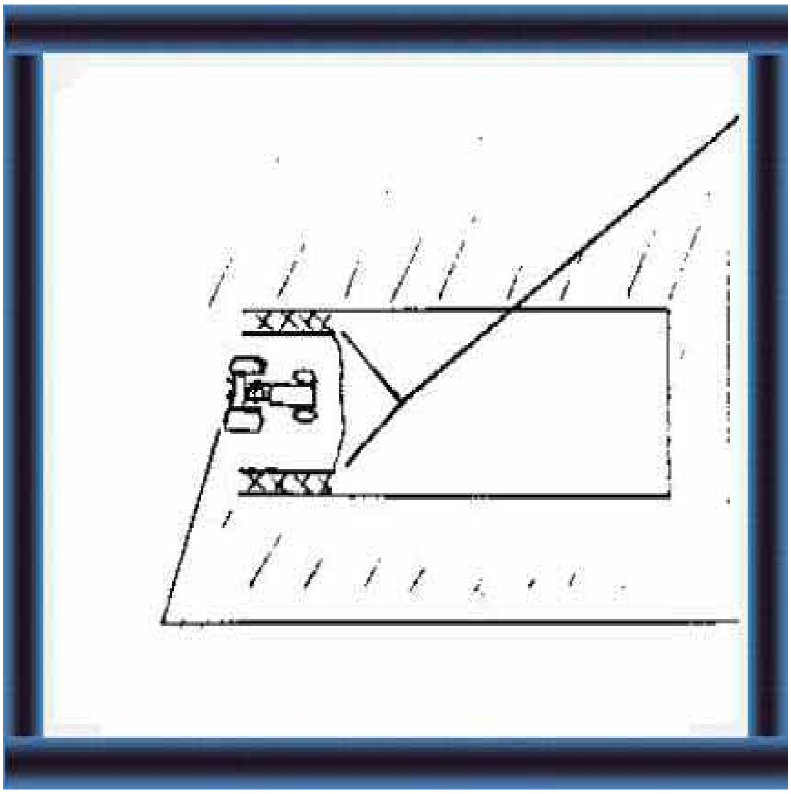
How can you make a trench silo?



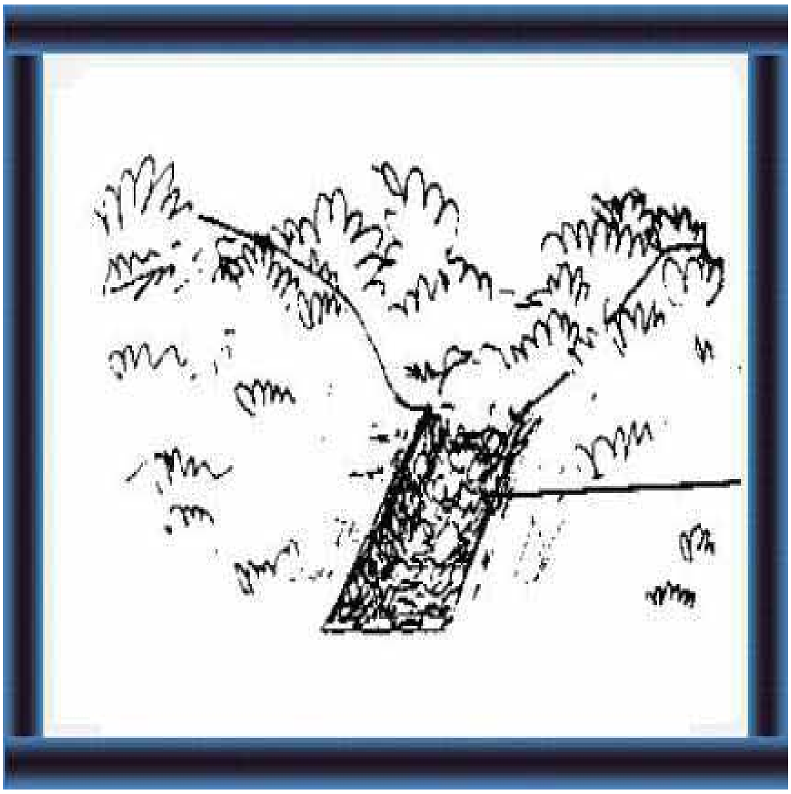
29 Choose a site with sloping land and firm soil. Side view



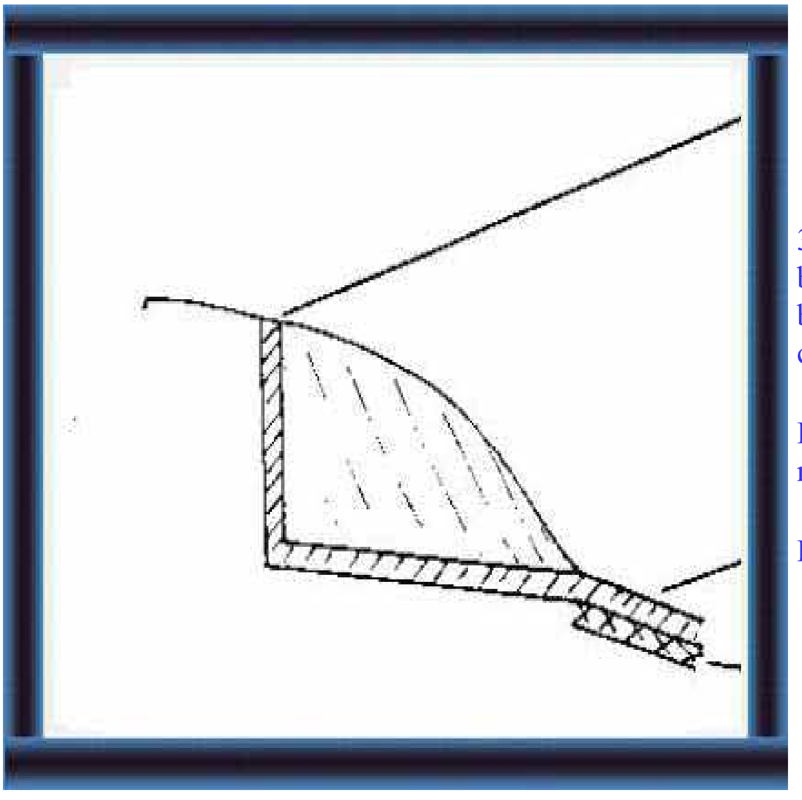
30 Dig a trench:
- with a 10% slope on the back wall and bottom. This will carry the waste towards the drains.



31
- wide enough for a tractor or cart to enter.



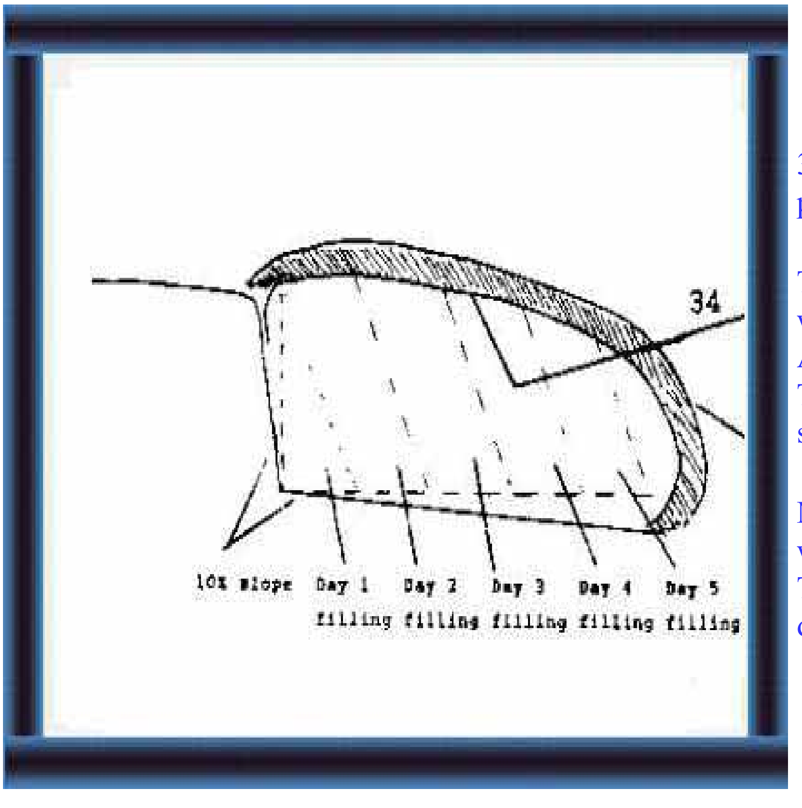
32 Dig drains and fill with rocks or stones.



33 Your trench silo will be better if you line the sides, bottom and walls with a 10 cm layer of concrete.

Extend the concrete for 3-4 m on the slope.

Drains



34 Cover the silage with a polythene sheet.

This will keep the air and water out.
Add a 15 cm layer of soil. This will compact the silage.

Make the slope of the back wall and bottom 10 %. This trench was filled in 5 days.

35 Make a roof.

This is bamboo with a "cadjan" covering.

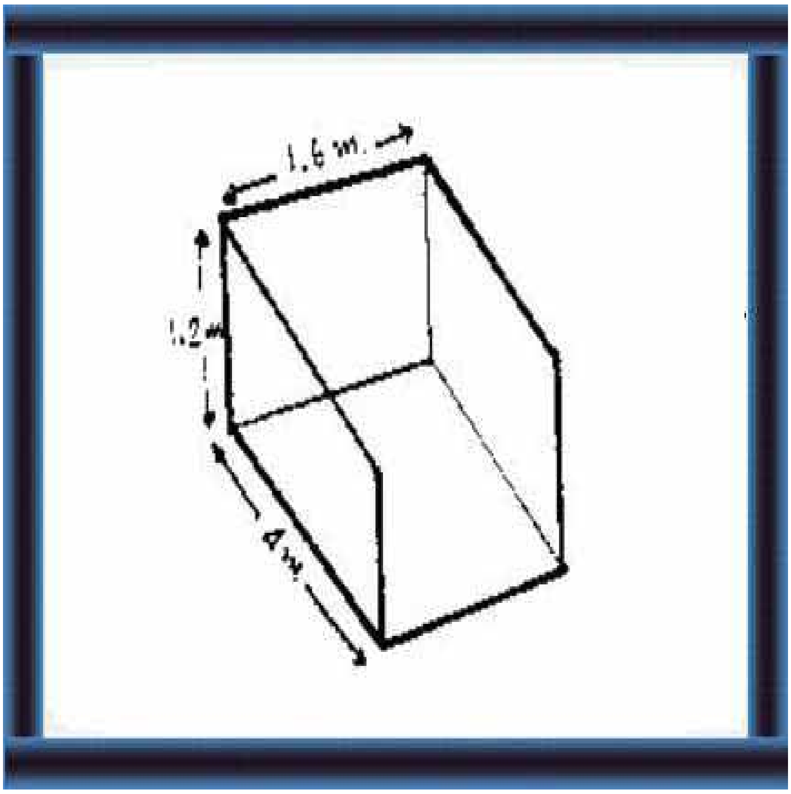
Materials

1 Broken stones (drainage)
2 Poles
3 Roofing material & ropes
4 Wood preservative

Labour

1 Dig trench
2 Make roof

Size
Capacity



36 This silo has a capacity of about 10 m^3 (3,500 kg).

This is enough to feed 2 cows and 2 calves for 60 days.

It is suitable for small - medium scale silage operations.

Note:
1 Replace roof mats every year.
2 Replace roof structure every 3 years.
3 Replace trench after 5 years.

Advantages

1 Low cost, about US$ 5-10 per m^3
2 Low waste because of walls
3 Easy to load and unload because at ground level.

Disadvantages

1 Needs a good, sloping site
2 Danger of water running into the trench, especially in tropical regions

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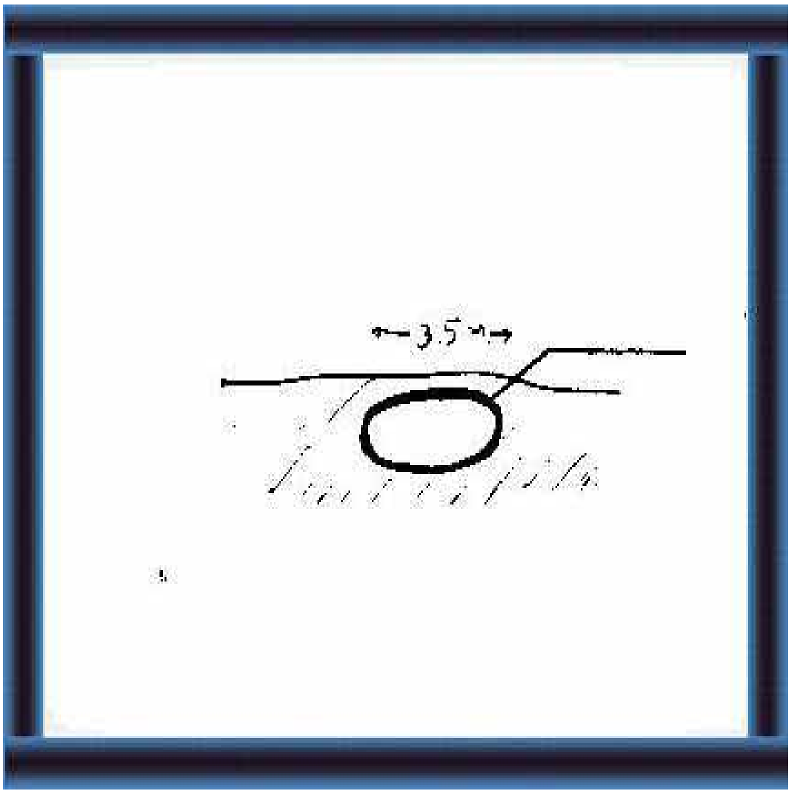
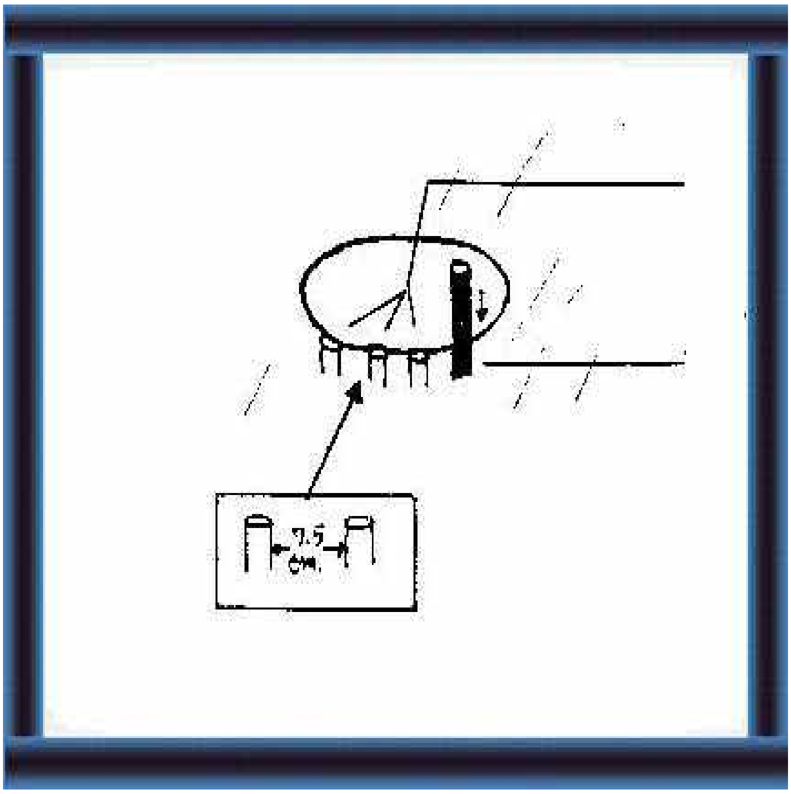
How can you make a circular wattle silo?



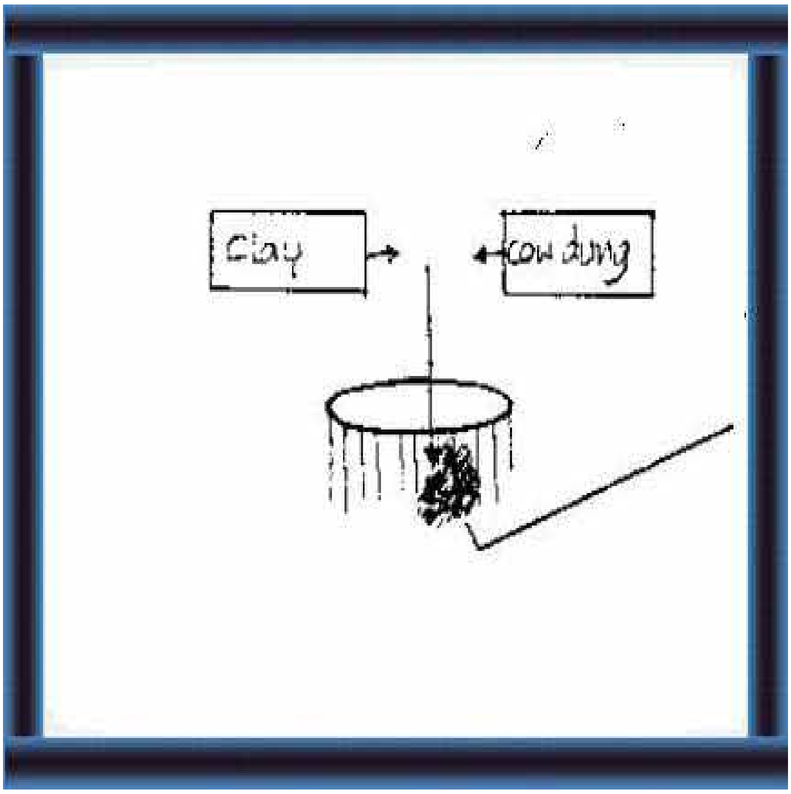
37 Choose a well-drained site with firm soil.

Draw a circle on the earth, 3.5 m in diameter.



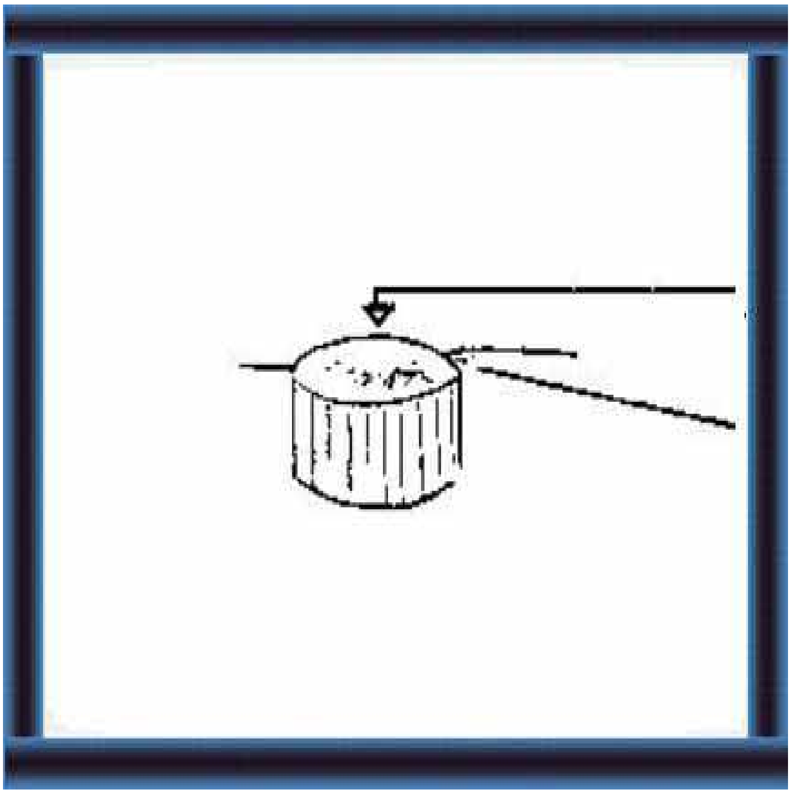
38 Make holes around the circle,
7.5 cm apart.

Errect the poles.



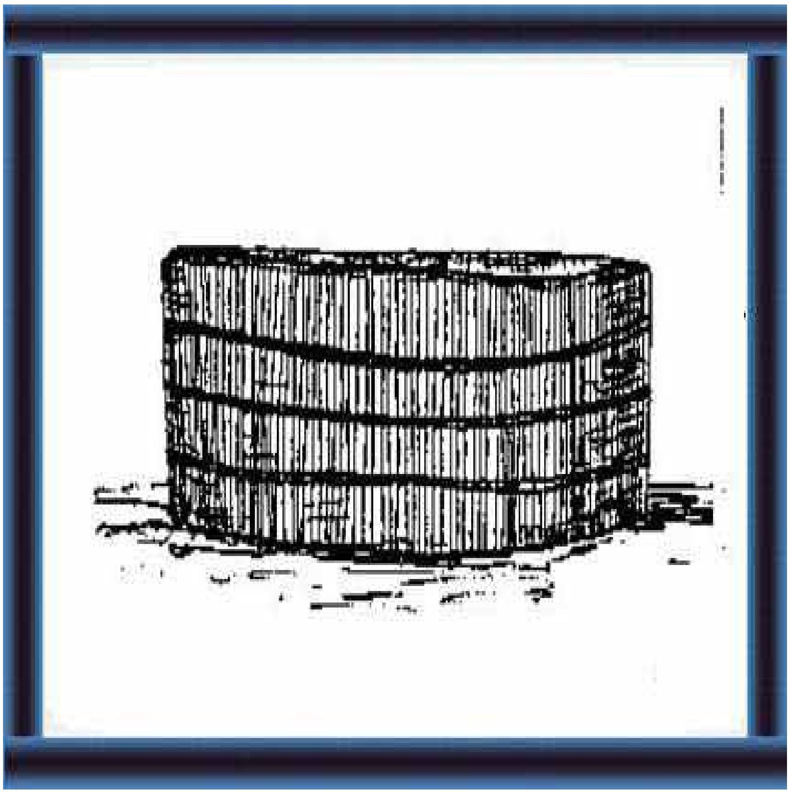
39 Mix clay and cow dung.

Plaster over the poles.



40 Add and compact the crop.
Seal the top with a mixture of soil and straw or with a plaster jacket.

41 Build a roof for the silo.



42 A "wattle and daub" silo.

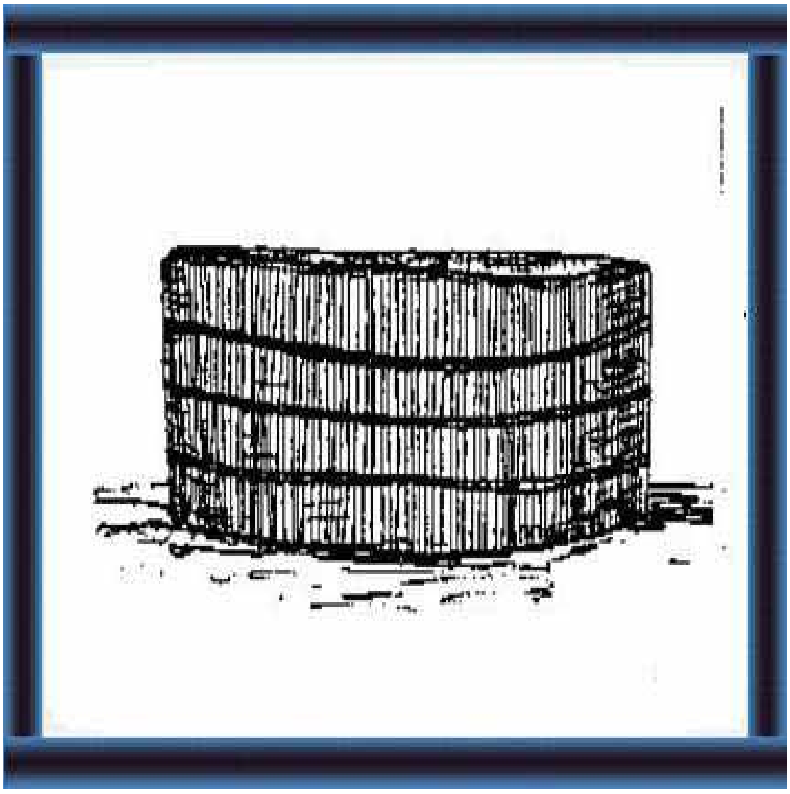
Materials **Labour**

1 140 wooden poles (2.20 m long, **1 Dig holes for**
poles
0/ 0.06 m diameter)

2 Poles **2 Erect &**
connect poles

3 Soil, cattle manure, **3 Prepare**
mud
straw chaff (to produce mortar
for wall coating)

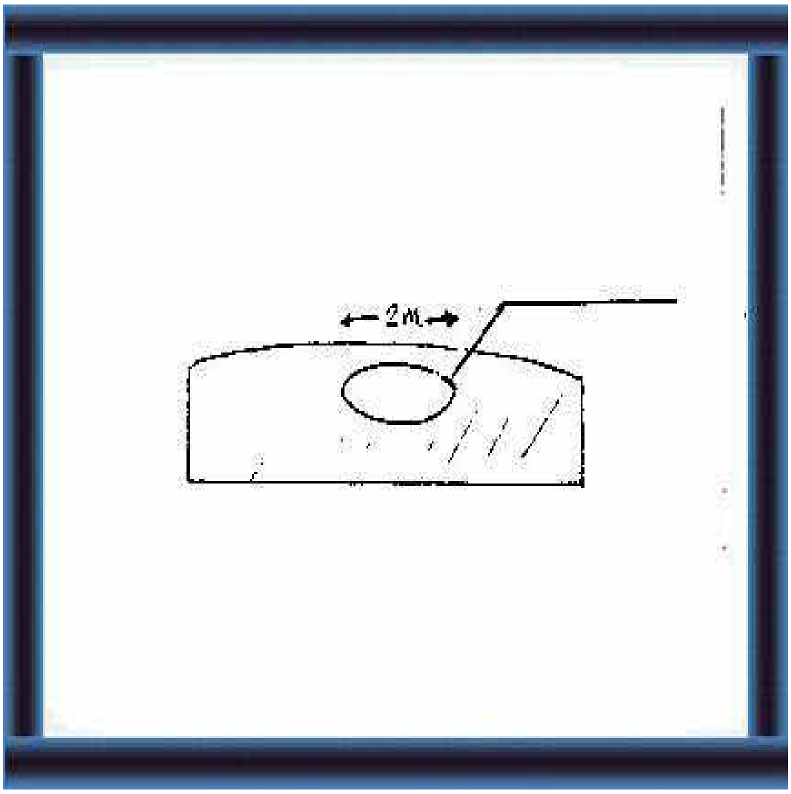
4 Plastic jacket **4 Plaster walls**



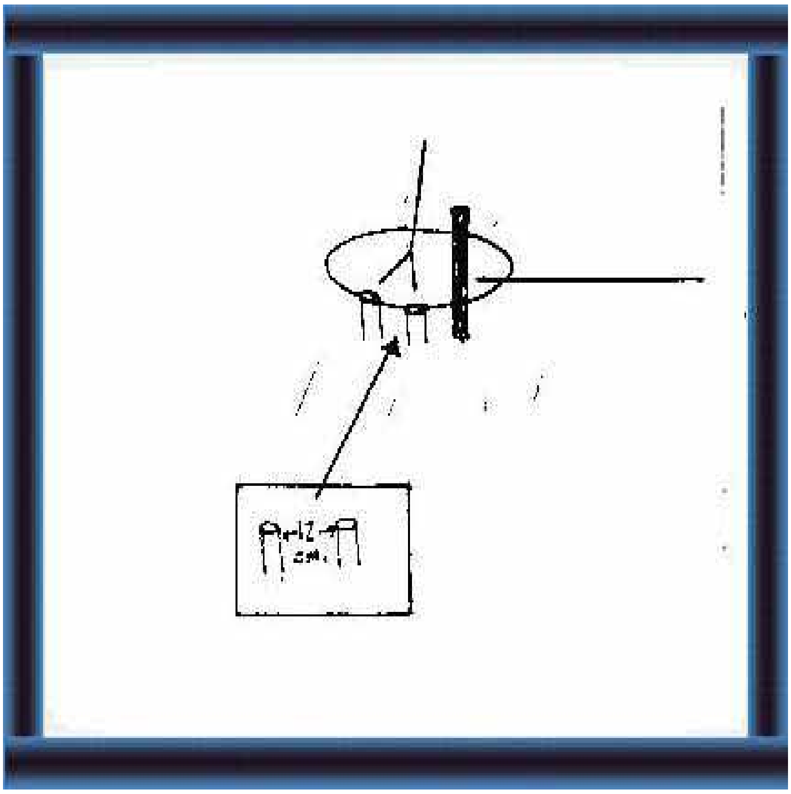
43 This silo has a capacity of about 18 m^3 (6,000 kg). This is enough to feed 3 cows and 3 calves for 60 days (daily ration: 25 kg/ cow, 6 kg/calf).

Note:
1 Replace plastic jacket after 1 year.
2 Replace basic structure after 2 years.

How can you make a bamboo silo?

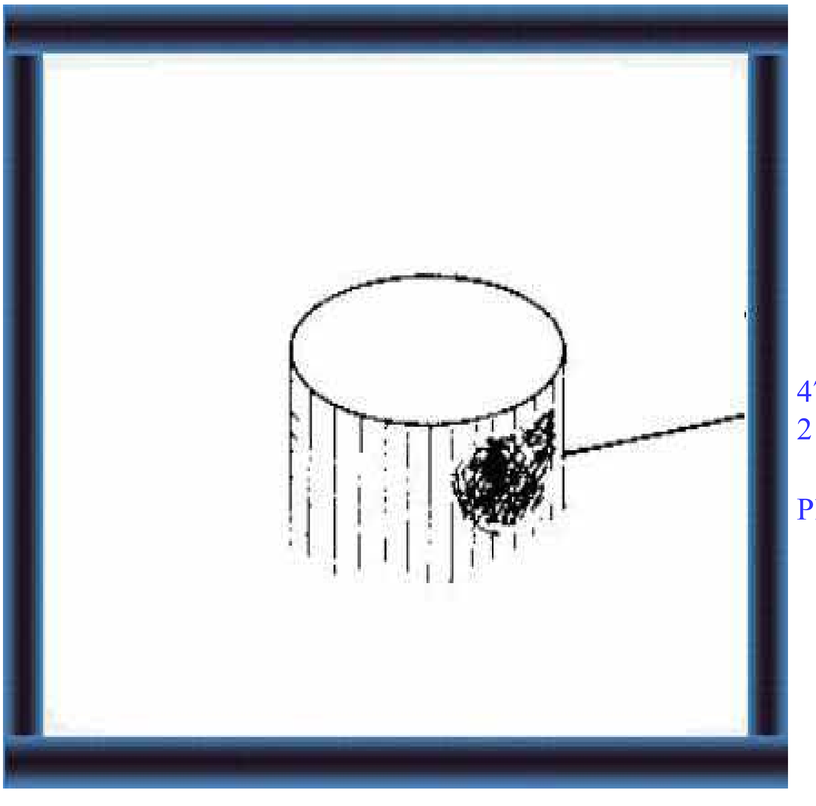


44 Choose a well-drained site with firm soil.
Draw a circle on the earth 2 m in diameter.



45 Make holes around the circle 12 cm apart.
Erect the poles.

46 Attach wire-mesh to the walls.
This supports the cement lining.



47 Mix 1 part cement with 2 parts sand and water.

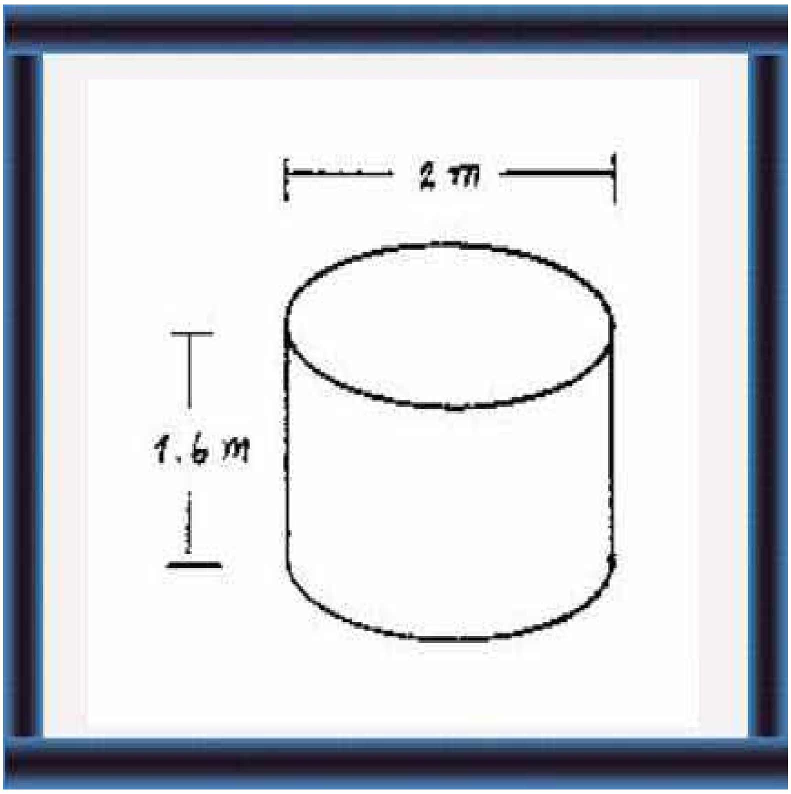
Plaster over the wire-mesh.

Materials

1 20 bamboo poles
2 Wire mesh (12.5 m)
3 Nails 1 kg
4 Seven sacks cement
5 Sand
6 Wood preservative
7 Binding wire
8 Roof (sugar cane leaf)

Labour

1 Dig holes for poles
2 Errect & connect poles
3 Prepare cement
4 Plaster walls



SIZE

48 Capacity
This silo has a capacity of about 5 m^3 (2,000 kg).
This is enough to feed 2 cows for 45 days.

Note:
1 Replace roof after 2 years.
2 Replace structure after 5 years.

Small-Scale

Dairy Farming Manual

Volume 3

Husbandry Unit 5.4 -Part 2

SMALL SCALE SILAGE MAKING

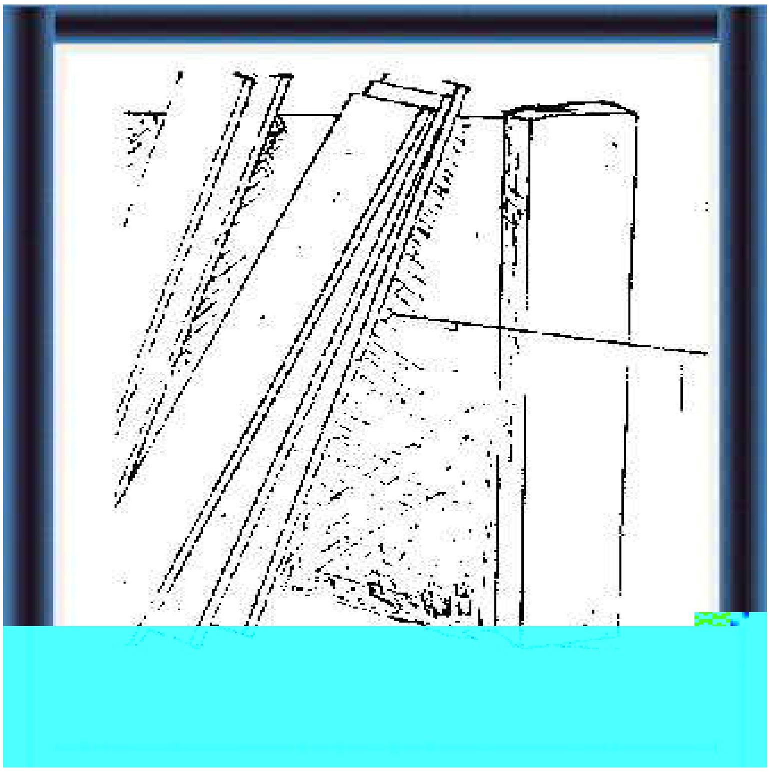
The Chamber Silo

49 The Chamber Silo

Materials

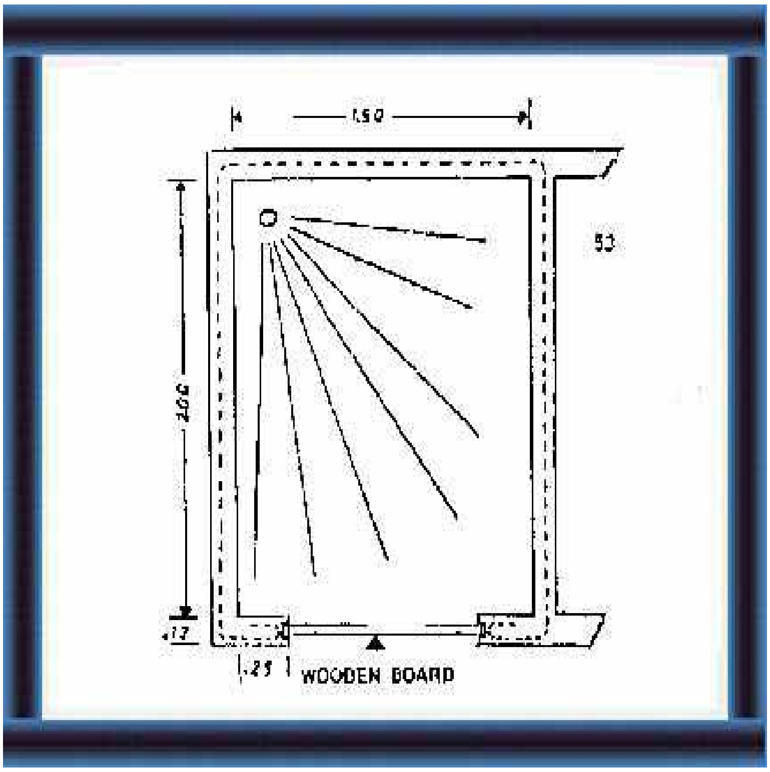
Walls **-Bricks (12 cm) 900 pcs**
- Sand 1.0 m^3 (for brick laying & coating)
- Cement 370 kg
- Iron wire 90 m (< 0/ 5 mm) (between every 2nd layer of bricks)

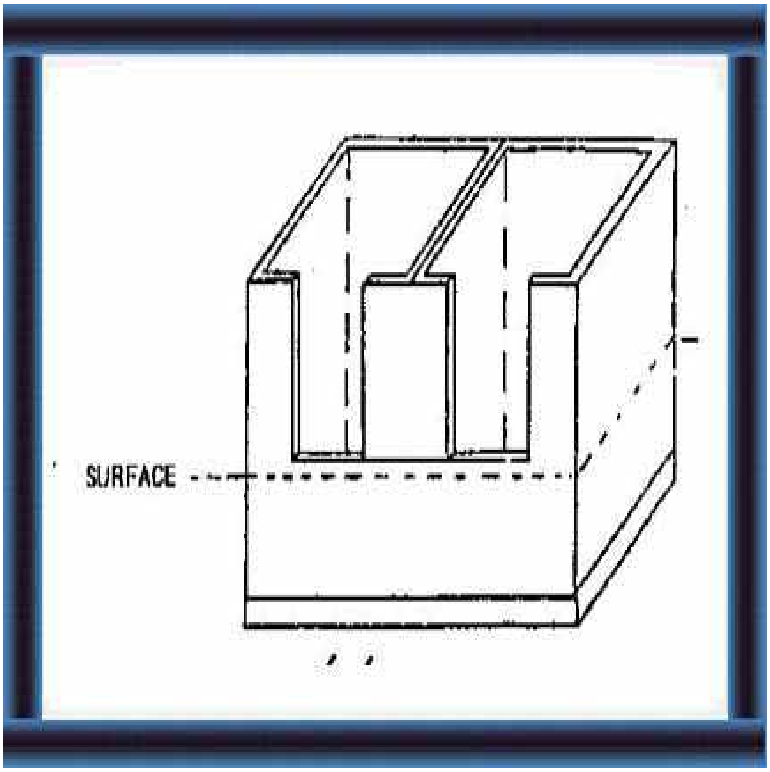
Floor **-Layer of gravel 0.30 cm**
-Gravel 1 m^3



50 Chamber silo with 4 chambers and roof.
This type of silo is quite expensive, but the silo can last for many years. You can fill and close each chamber separately so you can fill quickly and reduce losses. You can add or remove slats at the front of each room. This makes it easy to fill the plant matter into the silo as well as remove the silage from the silo.

page 159





52 Specifications:

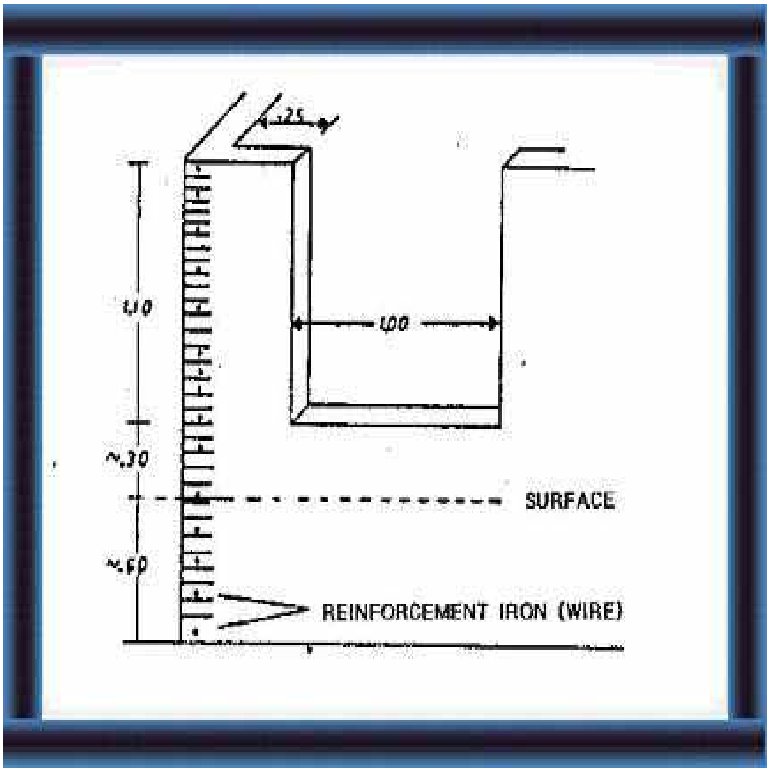
Silage requirements:

To feed 3 milking cows for 30 days.

Silo measurements :

2.00 m x 1.50 m x 2.00 m= 6.00 m^3

(per chamber)



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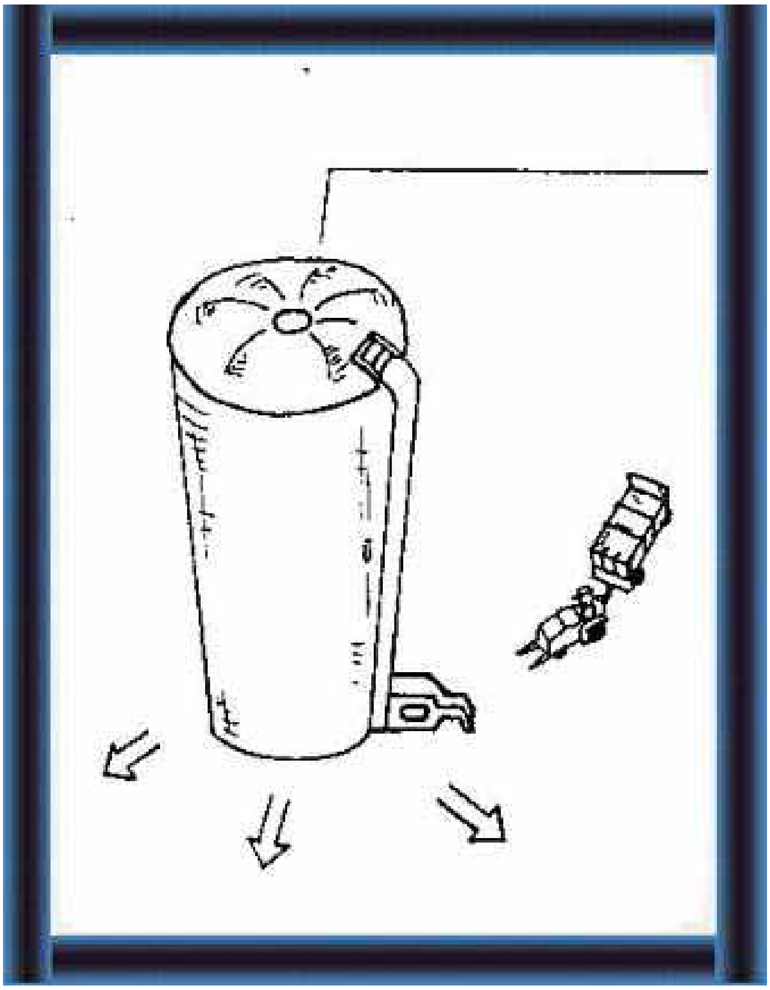
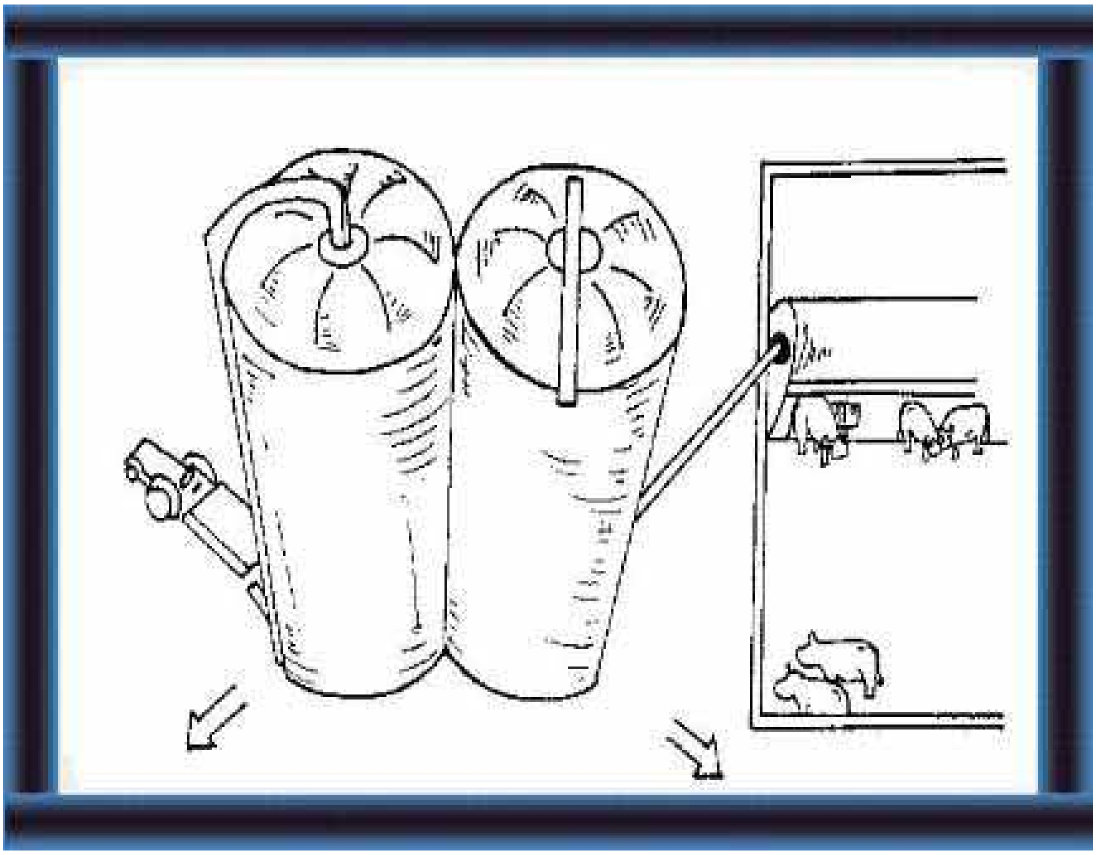
54 Large upright silos are convenient and not expensive if labour costs are high. They keep air out to reduce losses. Unloading structures and mechanical feed handling systems make it easy to fill and feed.



Important
1 Locate silos carefully, plan the location of other structures.
2 Fill and feed out quickly to avoid top spoilage.
3 Arrows show drainage away from silo.
Investment (1986): First cost US$ 12-16 per ton capacity



55 **Investment (1986):** First cost US$ 20-35 per ton capacity

How can you prepare your crop for the silo?

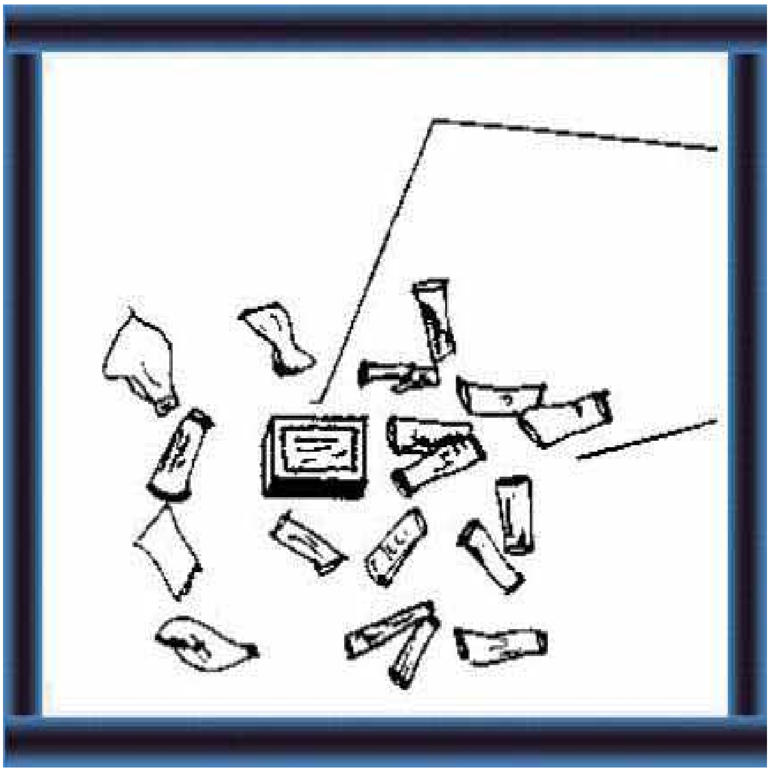
Cutting

Cut the crop at the **right time** to get the **best feed value**. Here are some examples:

Crop	Cutting Time
Lucerne	**full bud**
Elephant grass	**before 1.5 m high**
Other grasses	**just before flowering**
Grass/shrub	**end of the rainy season**
Oats	**beginning of the "dough" stage**
Maize	**50-55 days after silking**

Wilting

Check the **dry matter content** of the crop. If necessary, wilt the crop **to 30-35%** dry matter content. This improves the feed value.

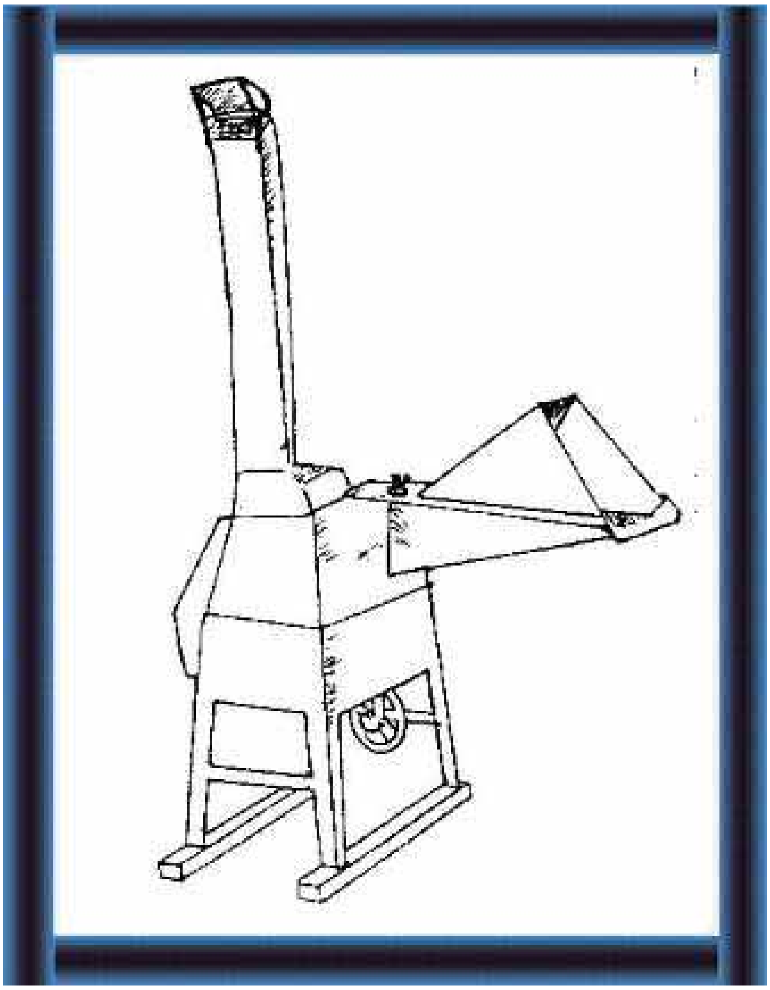


Chopping

Chop the crop to a length of **30-35 cm**.

56 This crop is chopped to the **length** of a **match box**. It is **easy to compact** and **remove the air**.

57 You can chop by **hand** but it is **slow**.
This is a problem because you must **fill** the silo **quickly**.



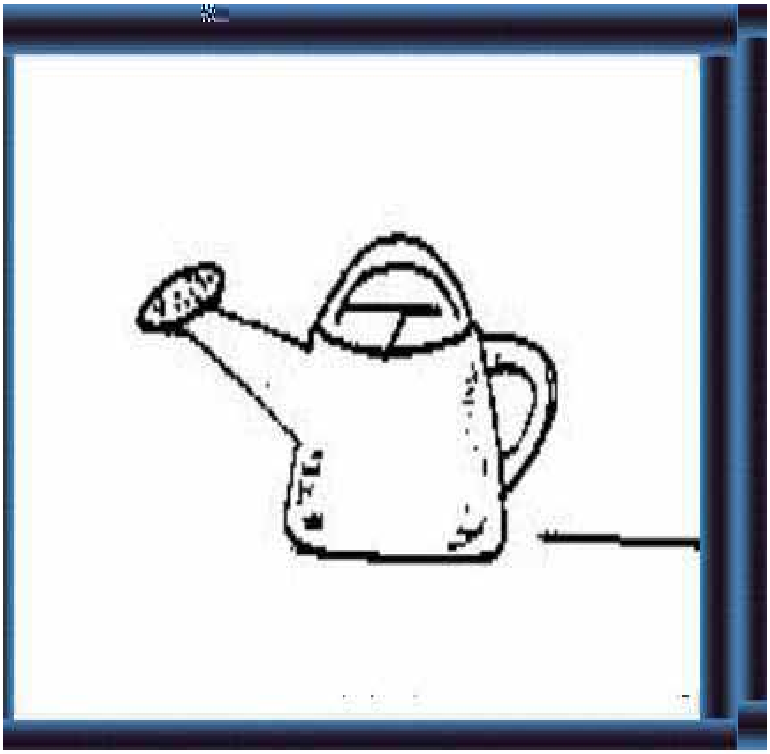
58 Machines are **expensive** but you can **share** them with your neighbours.

This one can chop **1,500 - 1,800 kg** of crop per hour and fill a **10,000 kg** silo in **one day**.

How can you fill and seal your silo?

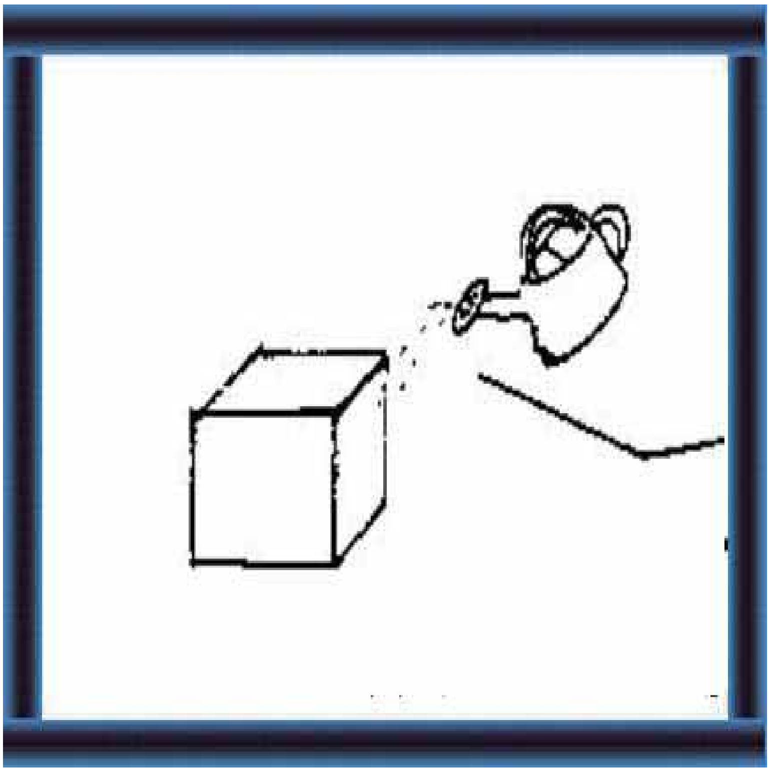
Silage Additives
You can **add** substances to the crop to make your silage **better** and **more quickly**.

Molasses
Some green plant material, e.g. young grasses and legumes, does not have enough carbohydrate to make a good silage. **Add molasses** to the crop to provide carbohydrate.

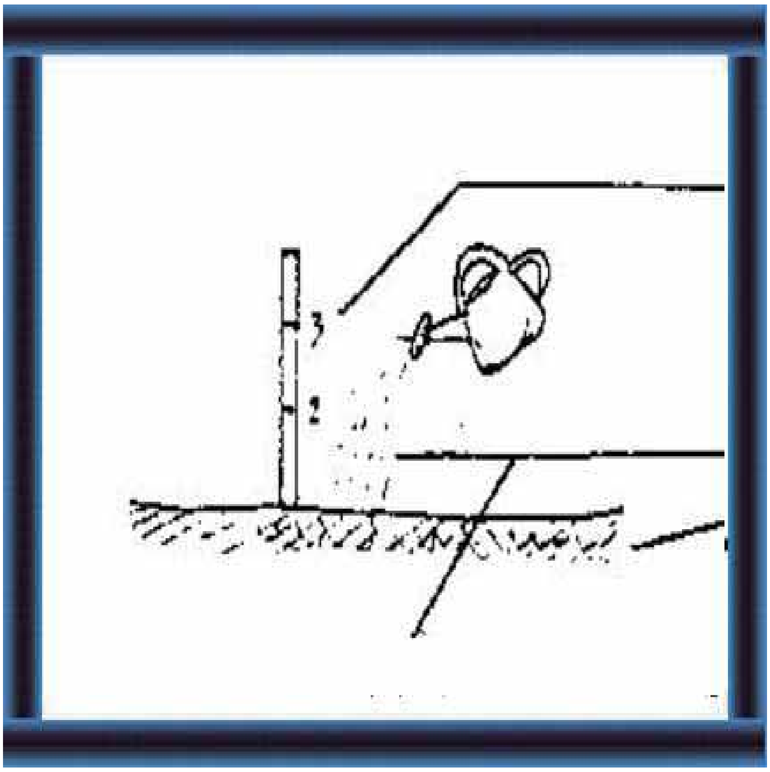


59 Mix **1 part of molasses** with **2 parts of water**.

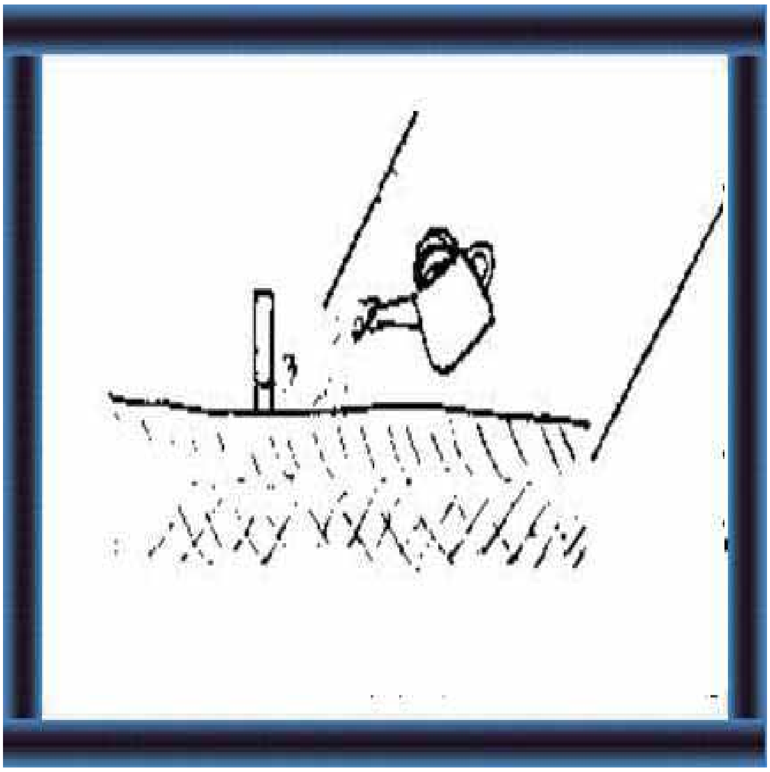
Put the mixture in a large sprinkling can.



60 Add **35 l of the mixture** for every **1 m^3 of crop** (less for short, leafy grass, more for legume crops).

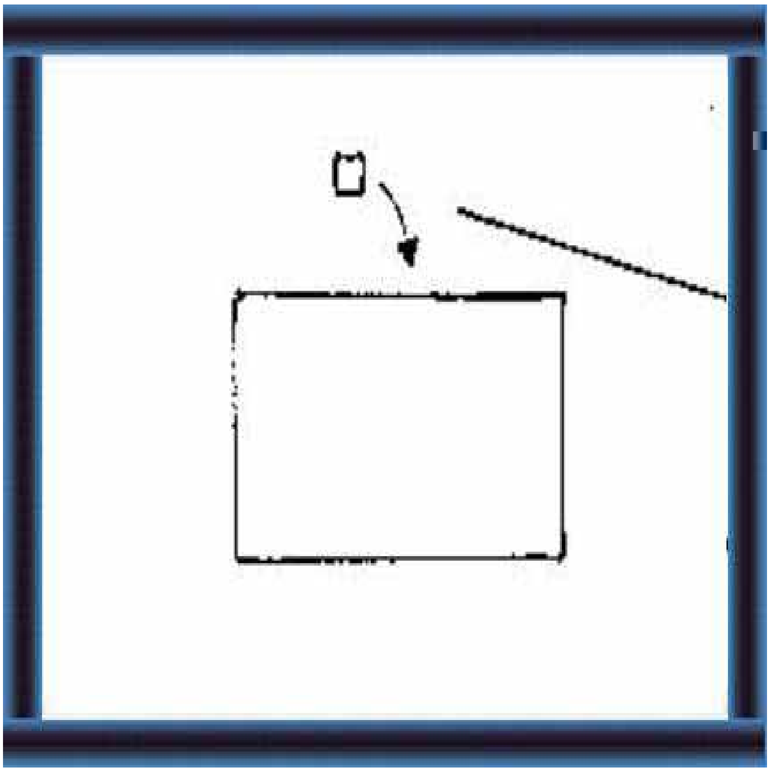


61 **Measure** the amounts of crop by **marking a pole** along the silo wall.
After adding **each layer** of crop, **sprinkle** on the **molasses mixture**.

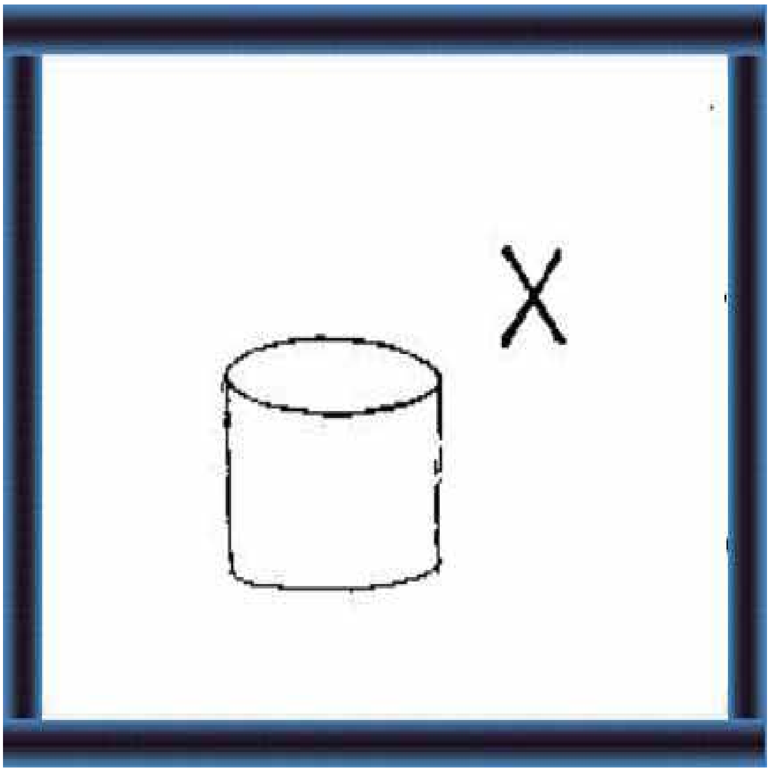


62 **Note**

Molasses is not so necessary:
- after wilting the crop
- for maize silage.

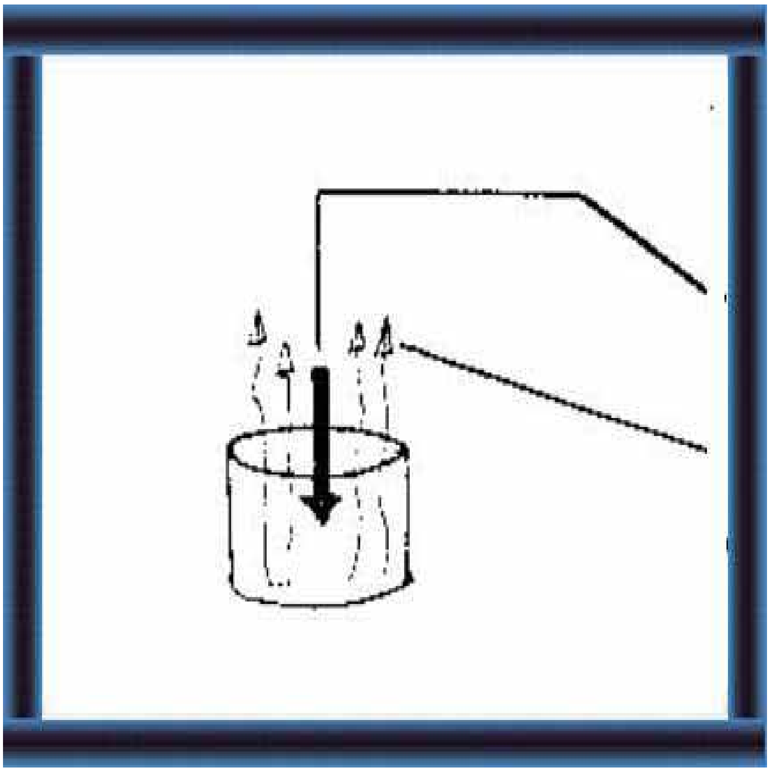


63 **Salt**
Salt helps the silage process in the same way as wilting. **Add 1-2% of salt** to the crop (less if the crop is dry, more if it is not so dry).



64 **Keeping out soil**
Do **not** put any crops with soil or other dirty material into the silo.

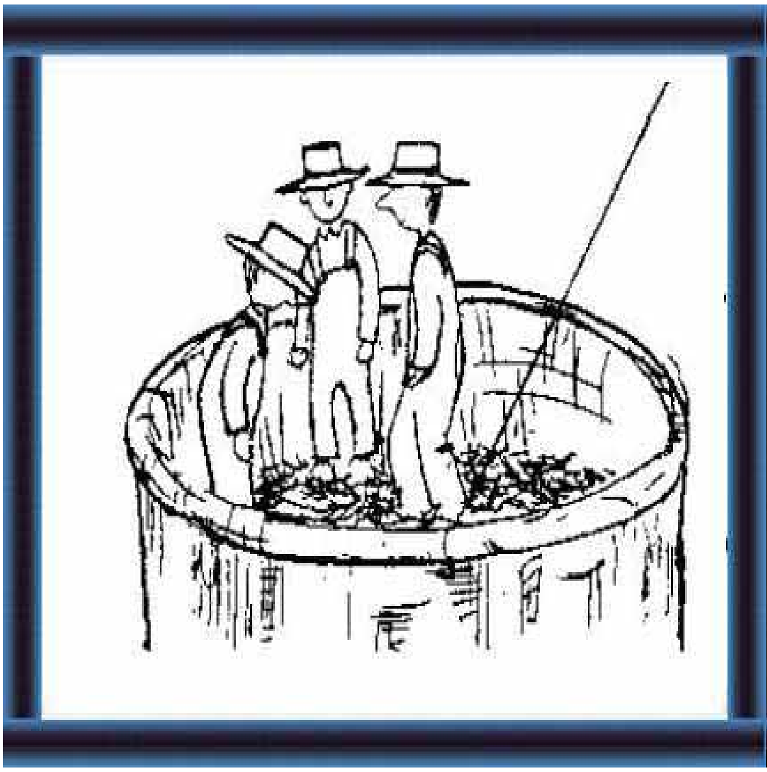
This will **slow down** or **spoil** the silage process.
.

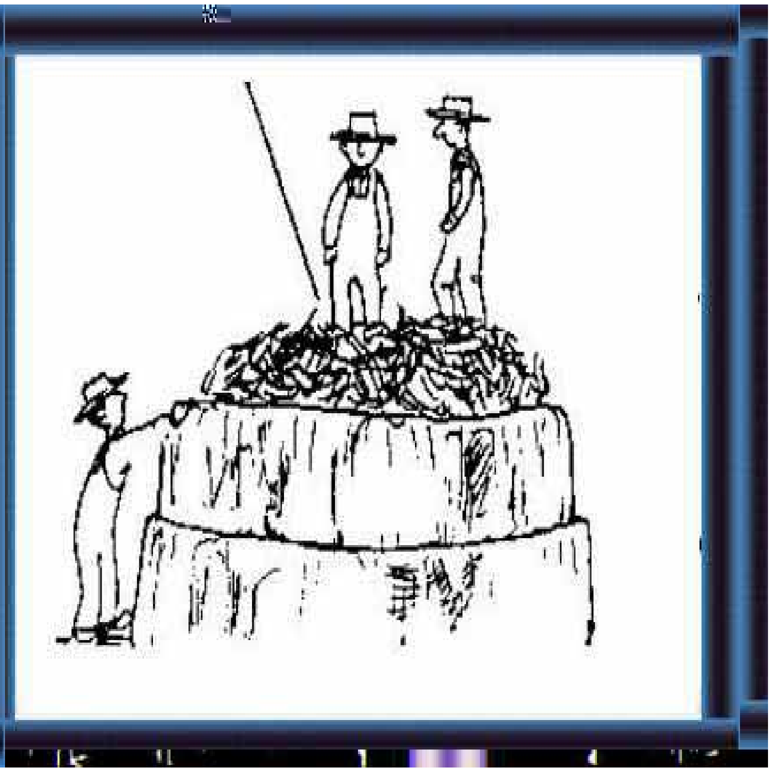


65 **Compacting**

Compact the crop **all the time** as you fill the silo.
This will **remove** the air

66&67 Compact the crop by **continuous treading**.

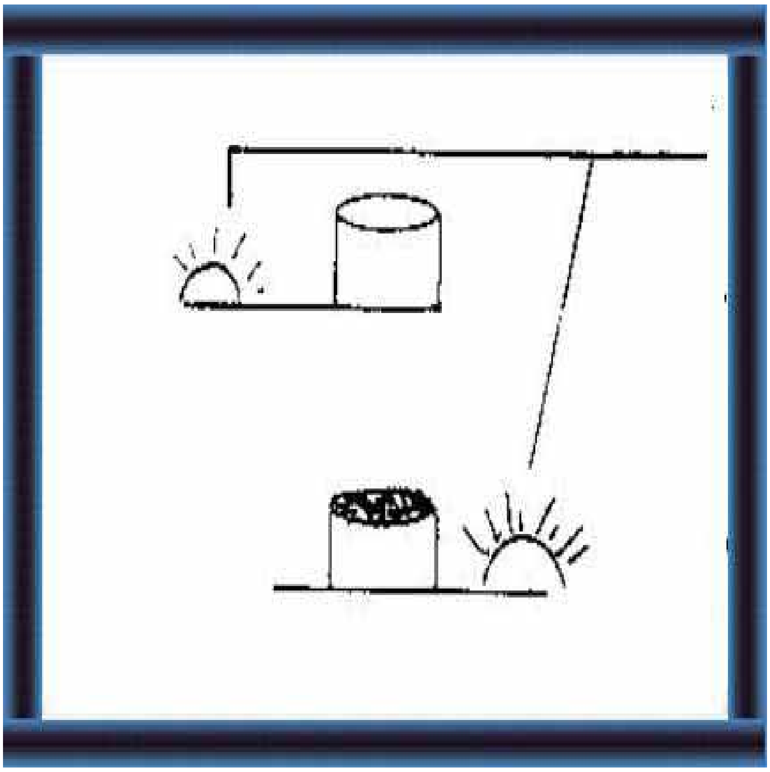




68 This farmer compacted his crop **well**.

The silage is **good**.
He can **slice** it with a spade and there is **little waste**.

69 This farmer did **not** compact his crop well.
The silage is **poor**.
It is **difficult** to **harvest** with a spade and there is a **lot** of **waste**.
You can also compact the crop by machine.



How long does it take to fill a silo?

70 **Fill** your silo in **one day** and **seal quickly**.

This will **improve** and **speed up** the silage process.

Important when planning:

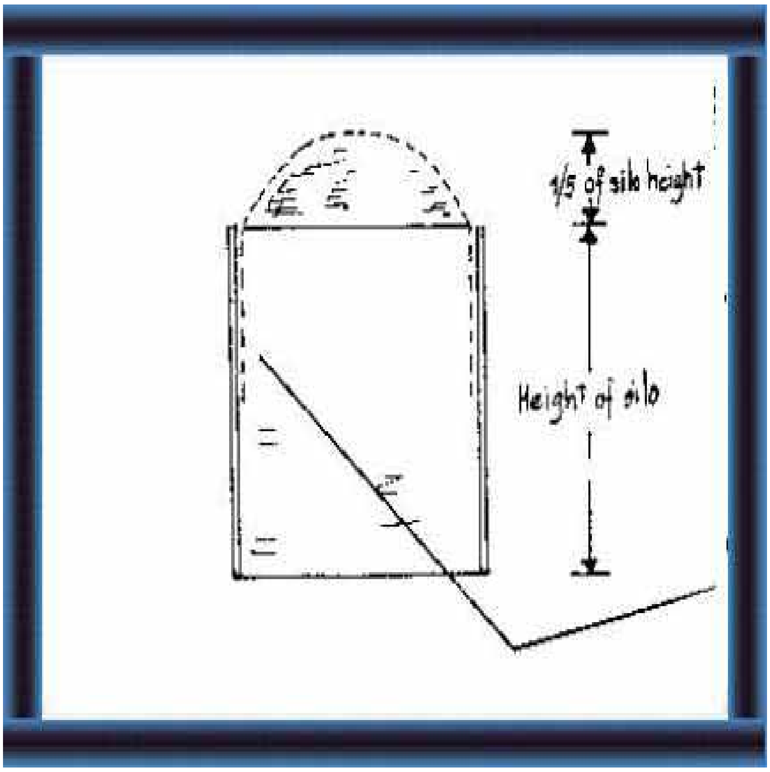
1 How long to chop the crop?

2 How long to put the chopped crop into the silo?

If necessary, ask your neighbours to help fill the silo in one day.

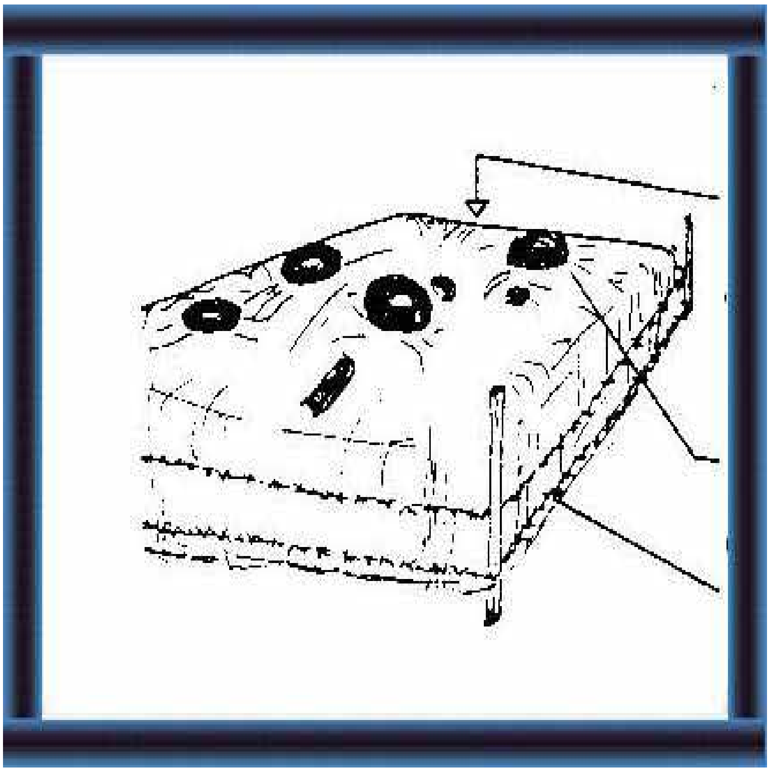
How can you seal a silo?

71 Fill the silo to **1 - 1.5 m from the top**.
Fix the plastic cover **inside** the silo walls.



72 **Upright silo** with **plastic cover**.
The plastic sheeting follows the inner side of the silo wall 1-1.5 m.

73 Fill the silo **above** the level of the edge.
Cover the silo with the plastic and **seal quickly**.



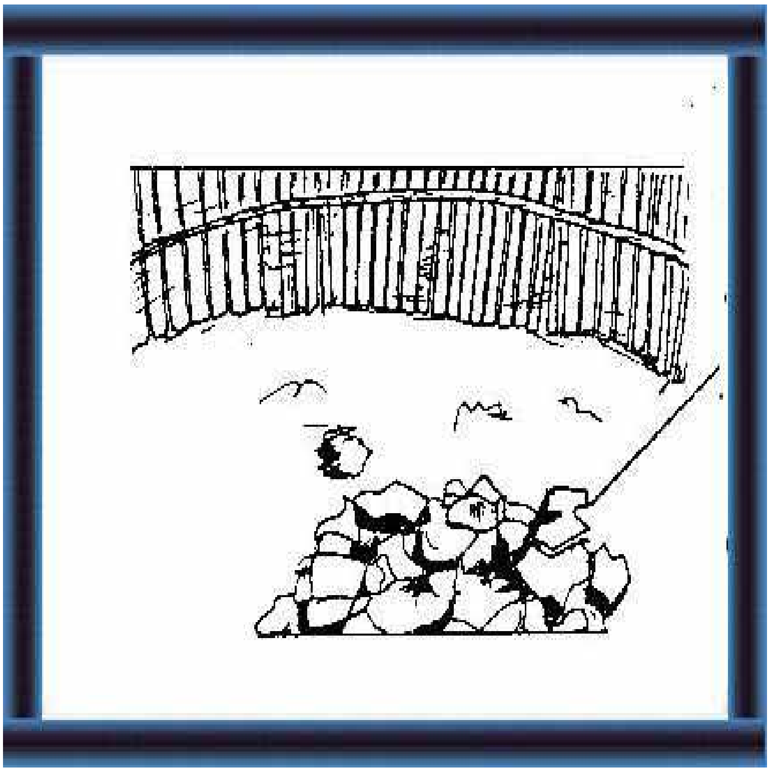
74 Place a layer of **soil** or **daub** on top.
This **protects** the plastic against **animals** and **sunlight**.
The weight also **compacts** the silage.
You can use old tyres for weight and a barbed wire fence to protect the cover against animals.

How can you drain waste from your silo?

75 **Dig drains** to carry the **waste away** from the silo.

Make sure the **waste** does **not go near your drinking water**.

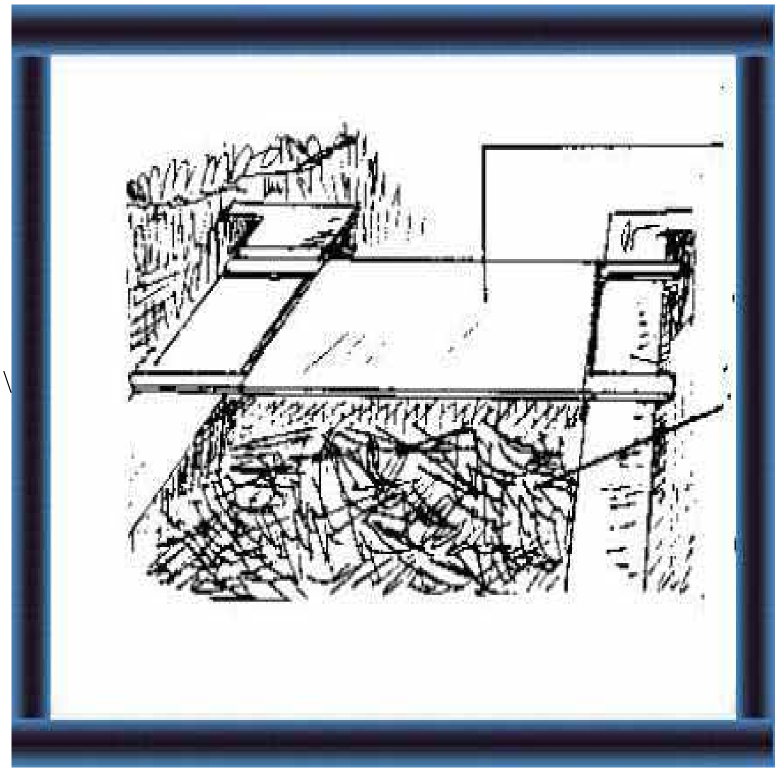
76 **Fill** the drains with **stones or crushed rocks**.



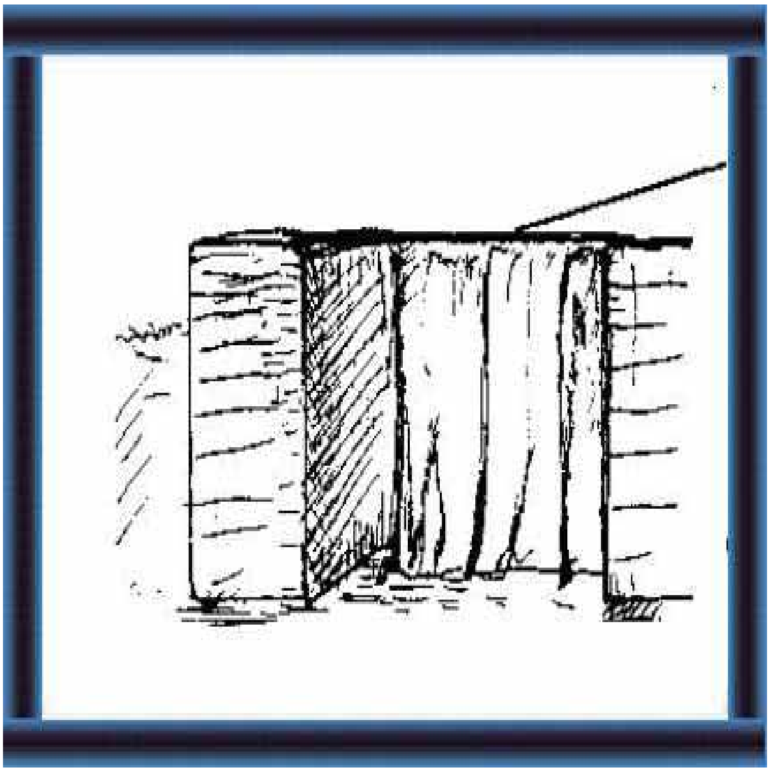
77

78 If there are no stones or rocks, fill the drains with **branches or twigs**.

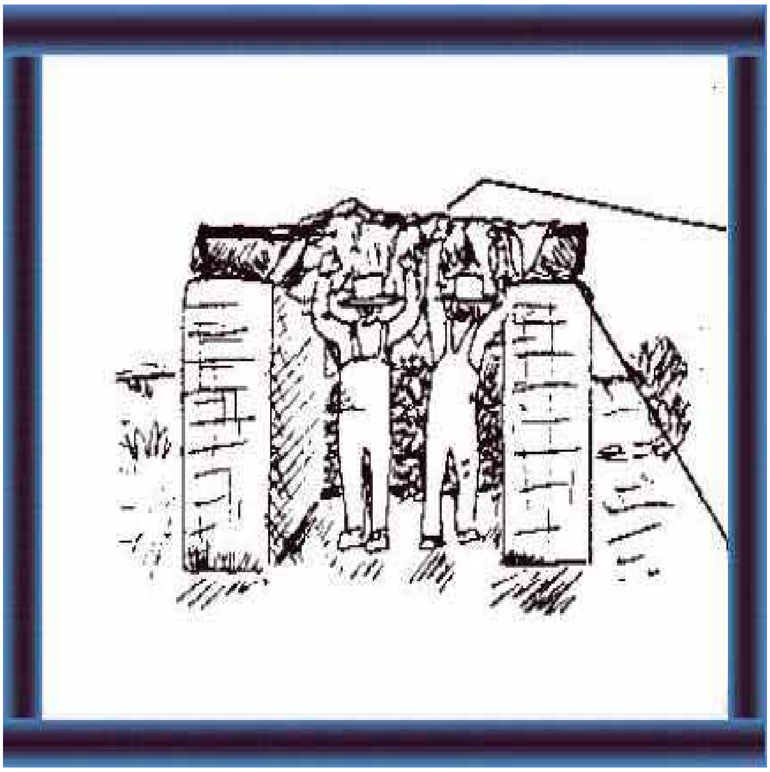
How can you remove and shelter your silage?



79 Make a **wooden platform** to **protect** the top part of the silo **against sunlight**.You can move the platform as you remove silage from the silo.



80 Nail **gunny bags** onto the wooden platform.
This **shades** the front part of the silo.
The **plastic sheet** (from sealing) also covers the silo.

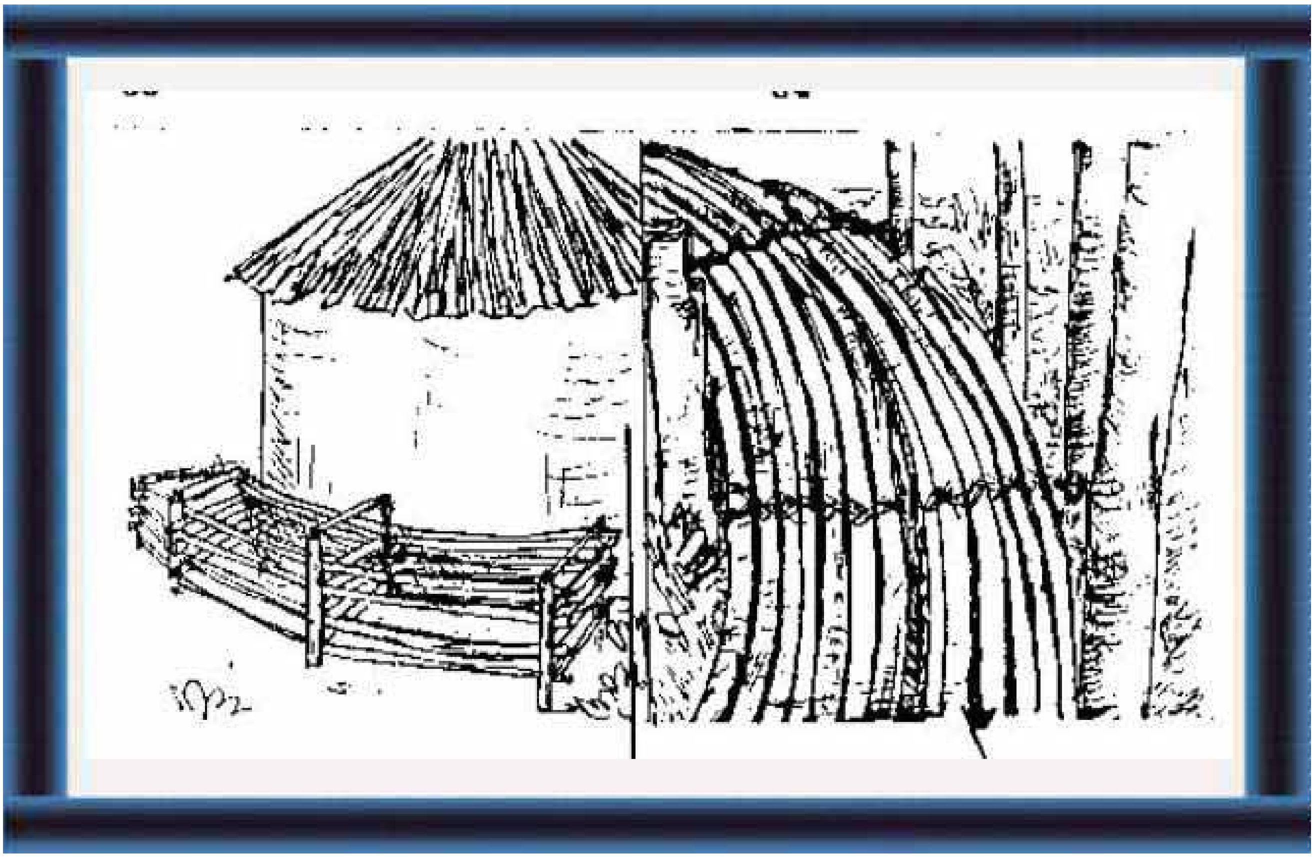


81 Make a **curtain** of gunny bags.
This is **easy** to **lift**.
Record **feeding instructions** in the black area.

82 You can **remove** the **roof** on this "**wattle**" silo.
This **shades** the silage surface during feeding time.

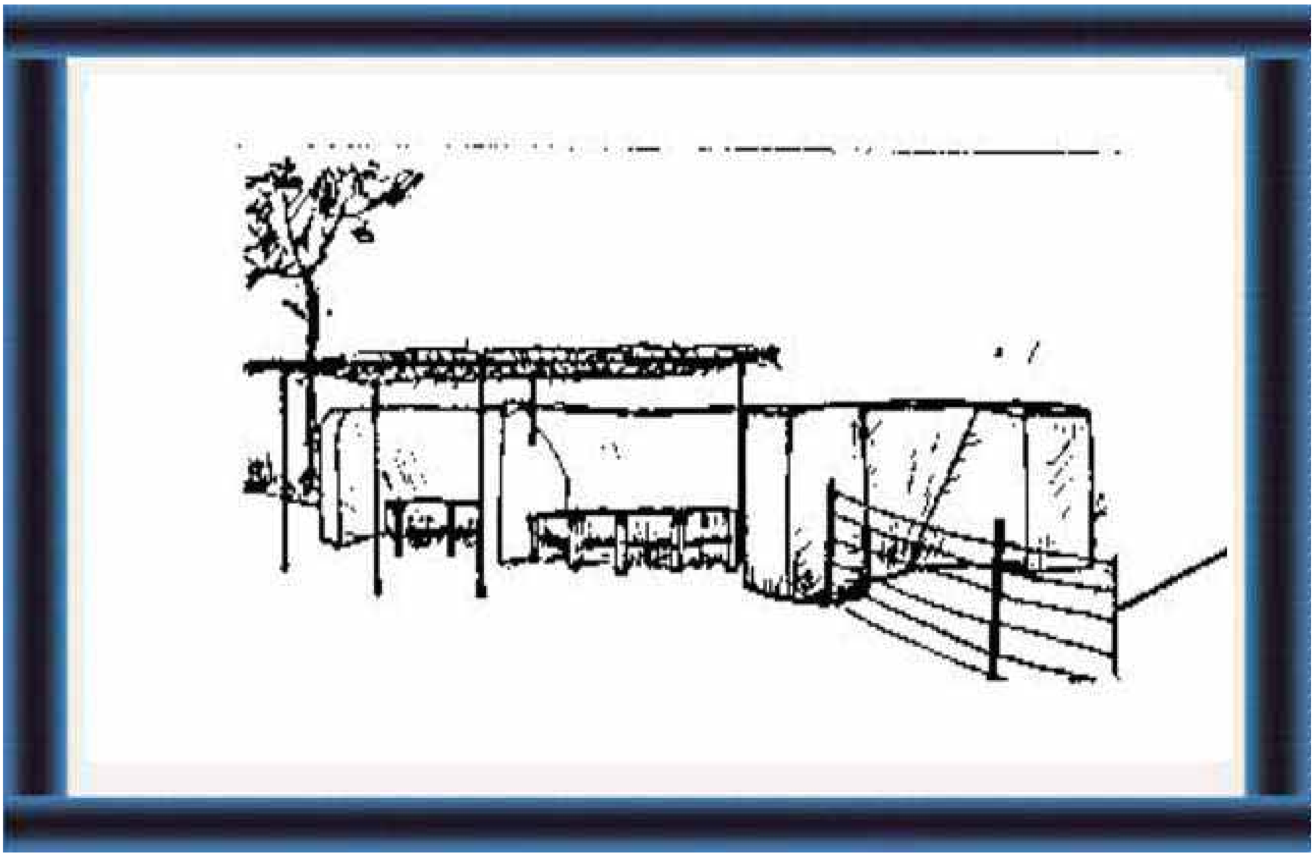
How do you feed silage?

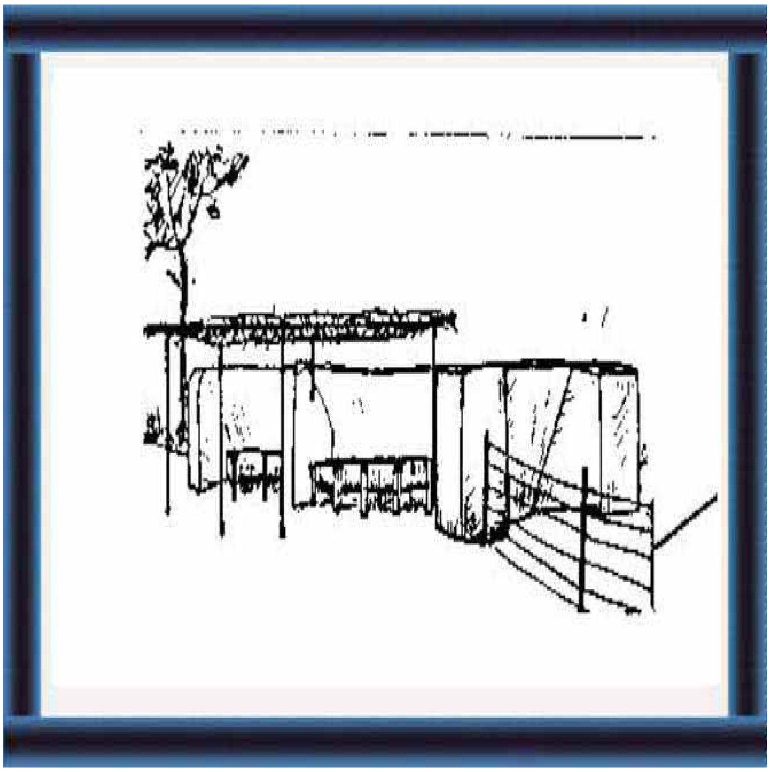
83 You can use a **filled wattle-and-daub silo**.
84 Make the **feeder** from **twigs**.



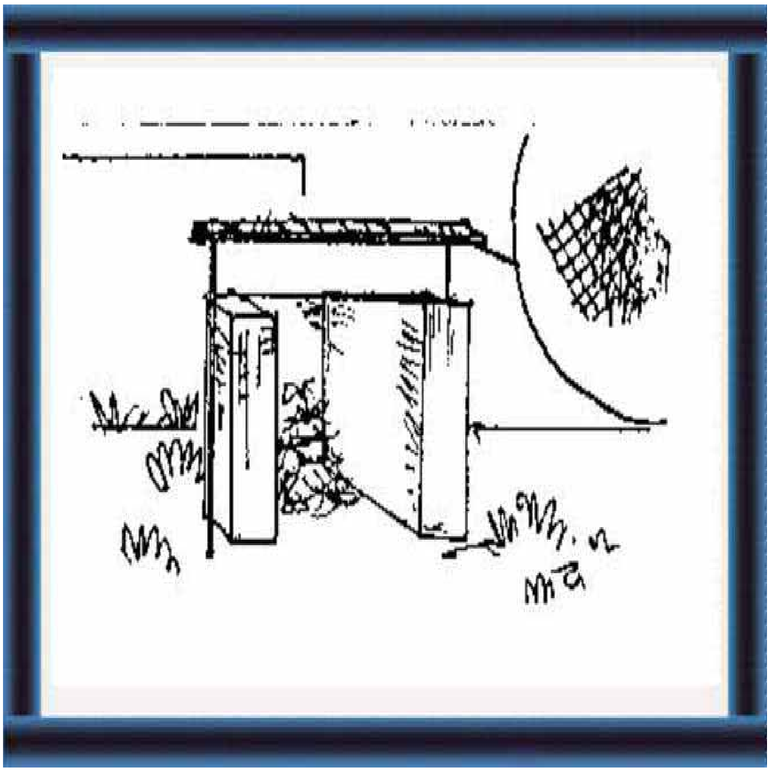
Brickwall trench silo

85 Build a **barb wire fence** to **protect** your silo.





86 Cut oil drums in half to make **feed troughs**.



87 Make a **simple shade** for silo.
Use wire-mesh and cover with straw.

How do you find the feeding value of silage?

The feeding value of silage depends on the type of crop and the success of the silage process.

Appearance

Value	Colour	Smell	Texture
High	Yellow green/ brown	Pleasant acid	
Medium	Dark brown	Sweet	Tobacco-like
Low	Olive brown	Foul	Slimy

Dry Matter Content

Take a wad of silage.
Twist in the hand.

Hand pressure	Amount of moisture	Dry matter content
High	None	More than 25 %
Medium	Some	About 25 %
Low	A lot	15% or less

What do you know about silage making?

Feeding good silage increases your milk production

Good silage:

1 has up to 85% feed value of the original crop	**(5-8)**
2 is fed when you have no other crops	**(9-12)**

Making silage for feed requires planning and equipment

Making a silo

Think about:

1 Location	
- cutting crop	**(13)**
- feeding	
- transport	
- drainage	
2 Size	
- costs	**(14-16)**
- one-day filling	
3 Strength	
- for compaction	**(17)**
4 Sealing	
- no air, water, sun	**(18-19)**
5 Drainage	
- capacity	**(20)**
- away from drinking water	
6 Base	
- for unloading	**(21)**

Types of silos

1 Stack silo	**(22-23)**
2 Wall clamp silo	**(24-28)**
3 Trench silo	**(29-36)**
4 Circular wattle silo	**(37-43)**

Small-Scale

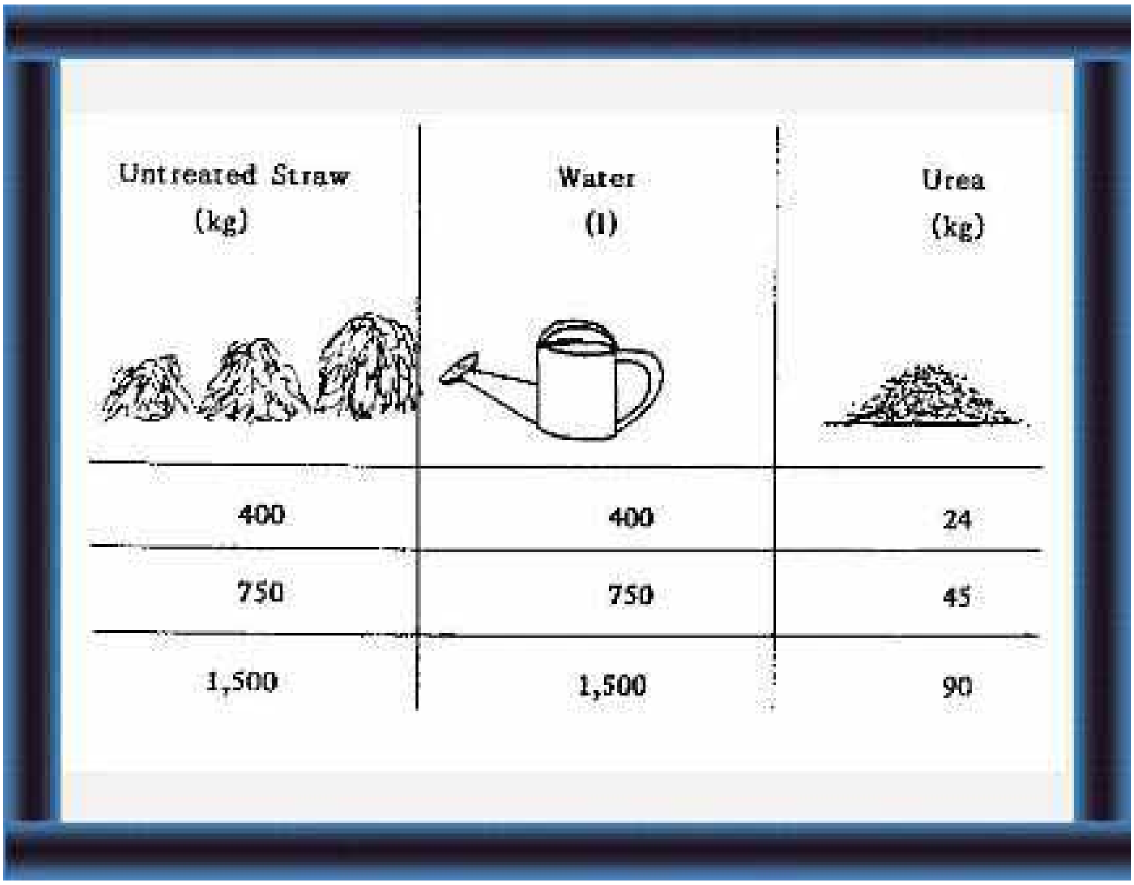
Dairy Farming Manual

Volume 3

Husbandry Unit 5.5

STRAW TREATMENT

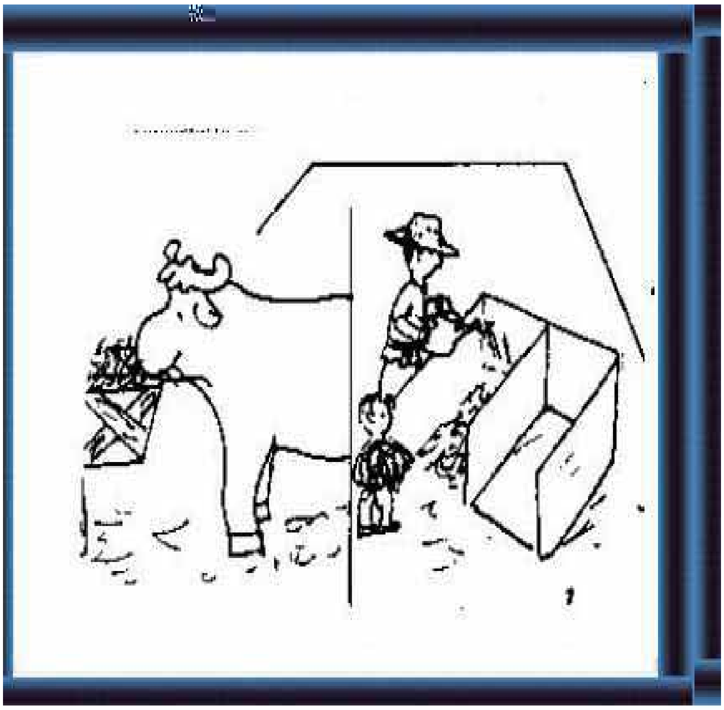
page 175



Untreated Straw (kg)	Water (l)	Urea (kg)
400	400	24
750	750	45
1,500	1,500	90

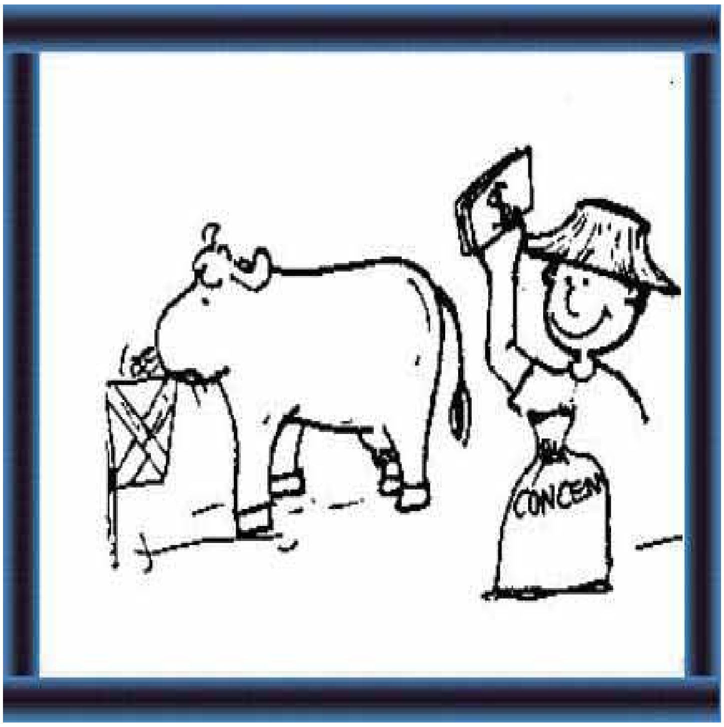
Extension Materials

What should you know about treated straw ?



Why should you treat straw? (5-13)

1 Treated straw has a **higher feed value** than untreated straw.
It is **easy to make**.



Is it expensive to treat straw? (14-17)

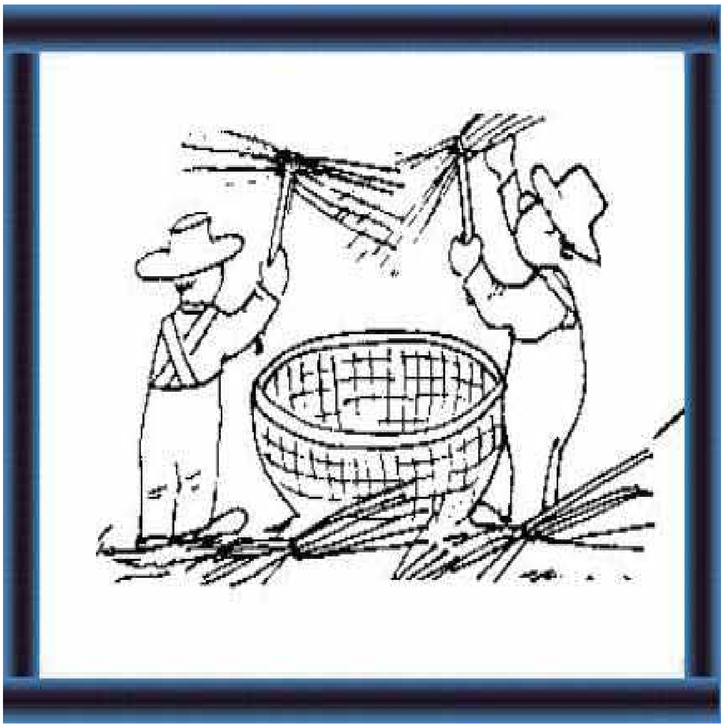
2 Making treated straw is **not expensive** and you **save money** on **concentrates**.

How can you treat straw? (18-49)

3 You should know how to:
- **make a stack** or
- **fill a chamber** with **straw**, **water** and **urea** and
- **seal** it with a **plastic sheet**.

How can you feed treated straw? (50-66)

4 You should know:
- **how** and **when** to take treated straw from the stack
- how to **supplement** treated straw with **concentrates** and **minerals**.

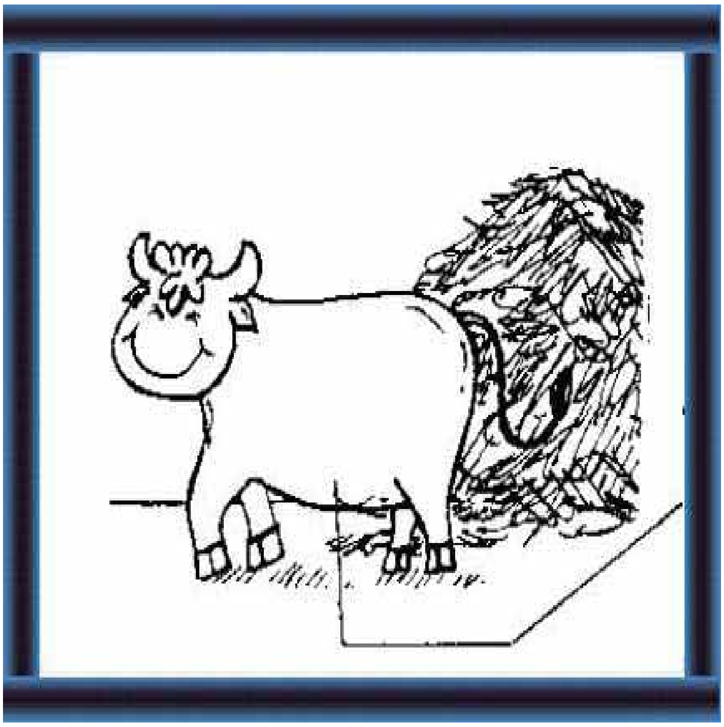


Why should you treat straw?
5 **After paddy harvest** and **threshing**, you have a **lot of straw**.

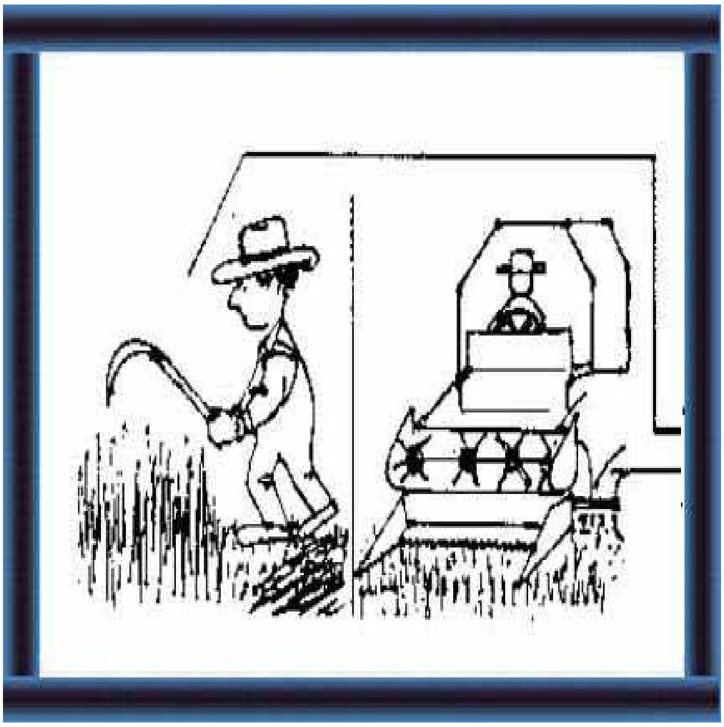
Should you burn it in the field?
6 **No!** You can use as a **maintenance feed** for cattle

but the:
- content
- dry matter digestibility
- balance

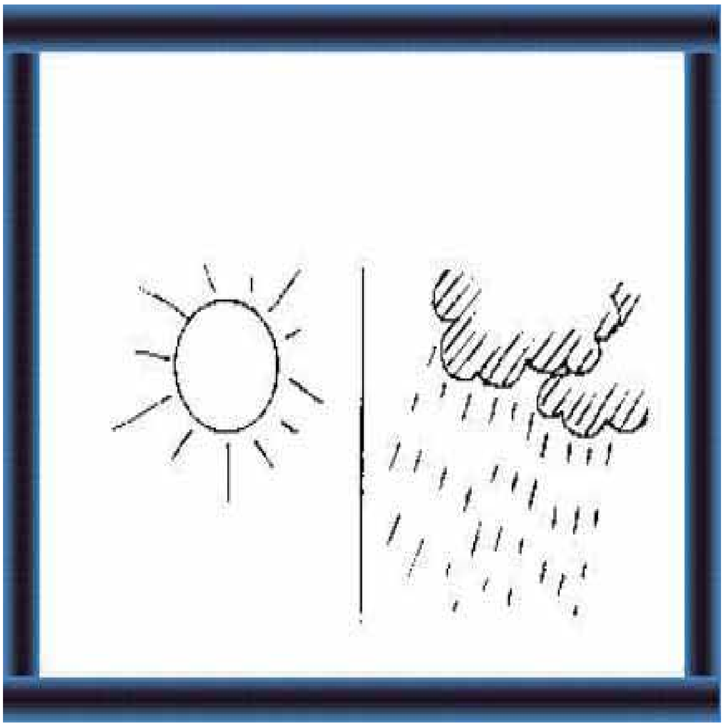
of untreated straw are **poor**.



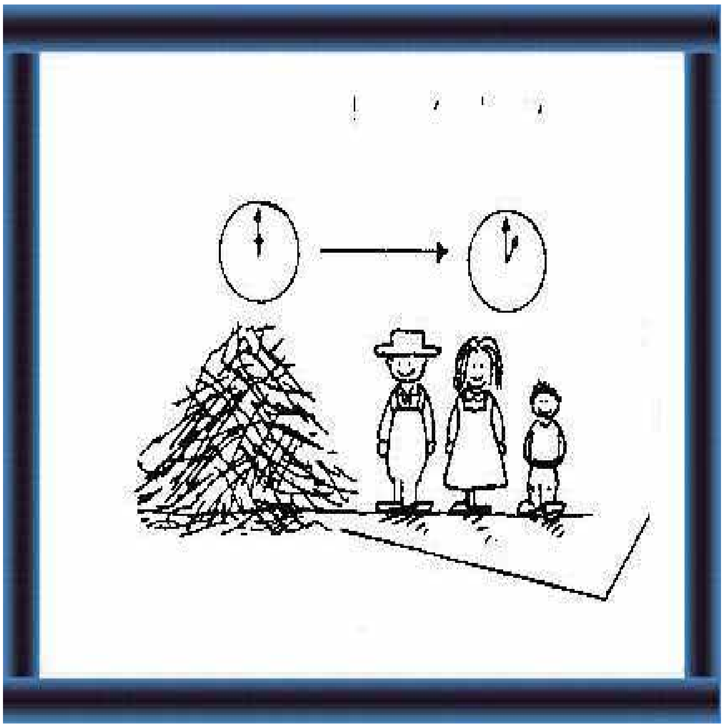
7 **Treat straw** with **urea**.
Treated straw has a **higher feed value**.
You make **better use** of your straw.



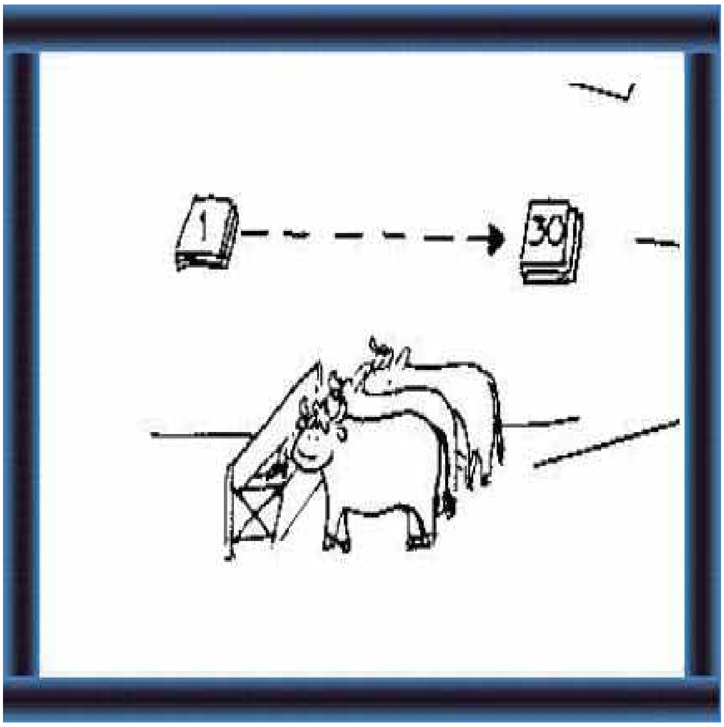
Is it difficult to produce treated straw?
8 You can treat straw under **all farming conditions** and on **all sizes of farms**



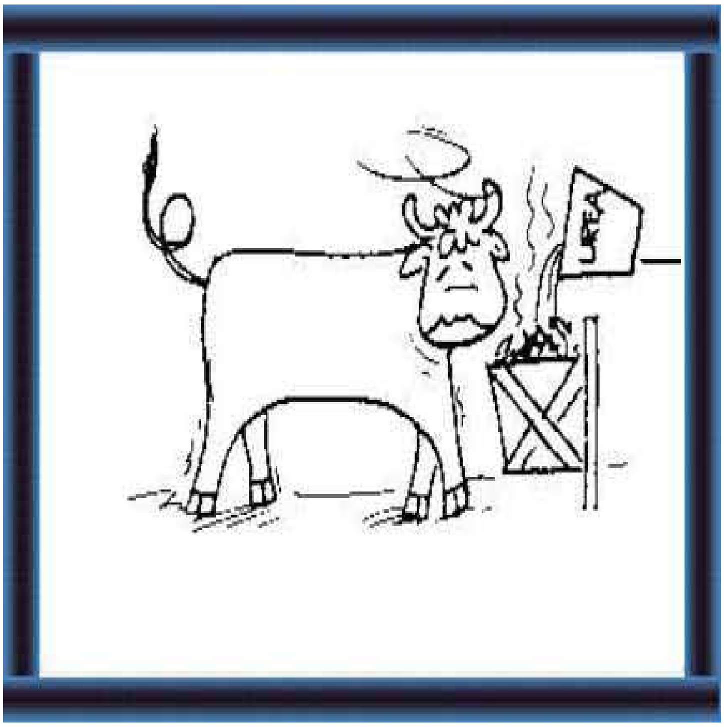
9 and under all **weather conditions**.



10 On a **small** farm you can make a **large amount** of **feed** at **one time**. A few hours work for you and your family

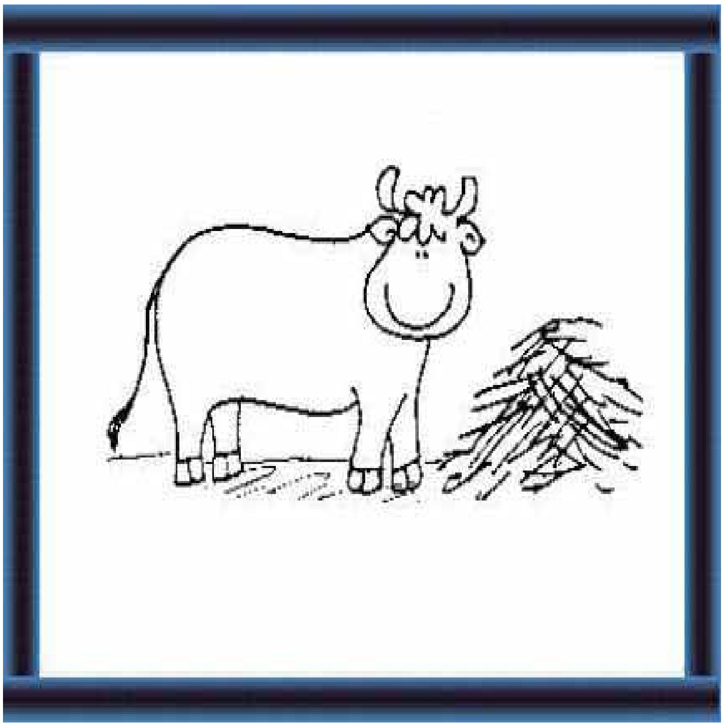


11 makes **enough feed** for **3 animals for 1 month**.



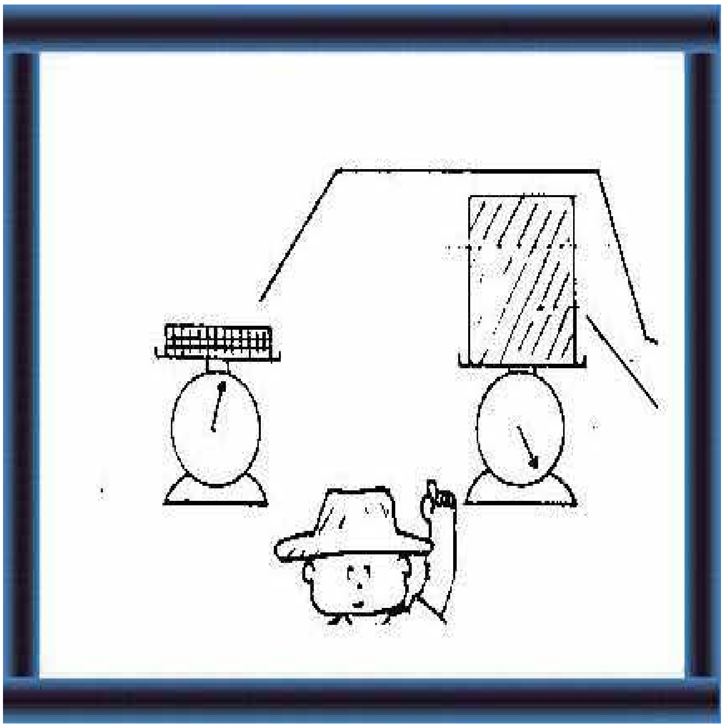
Why not feed urea to your animals?

12 **Urea** can be **toxic** if you use it directly as a supplement for roughages.



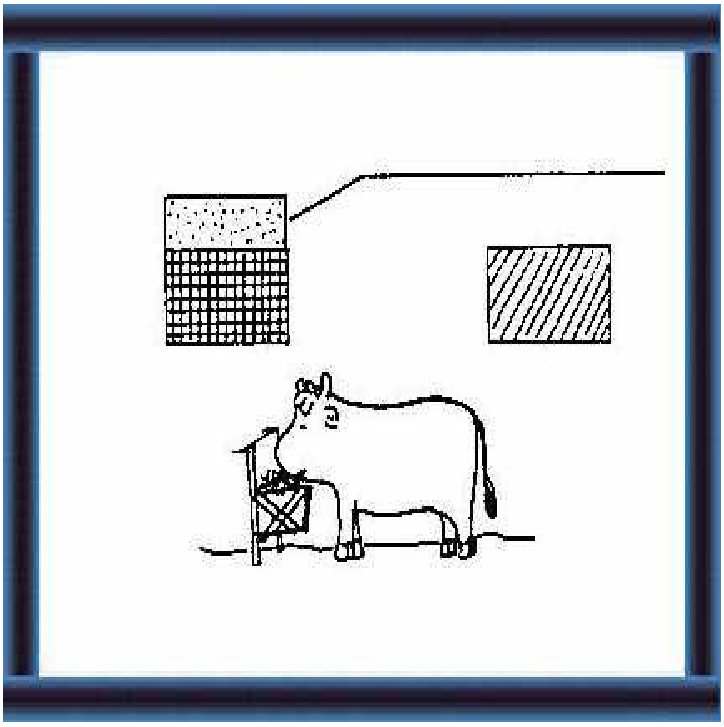
13 When you treat **straw** with **urea** and feed it to your animal, it is **fairly safe**.

After a few days, animals **like** to eat treated straw.



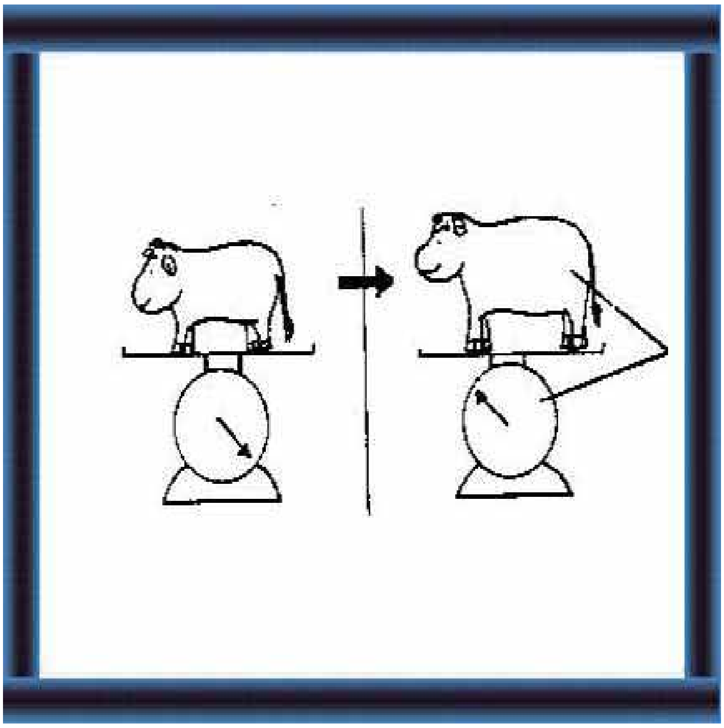
Is it expensive to treat straw?

14 **10 kg** of urea-treated straw **costs** the **same** as **80 kg** of untreated straw.

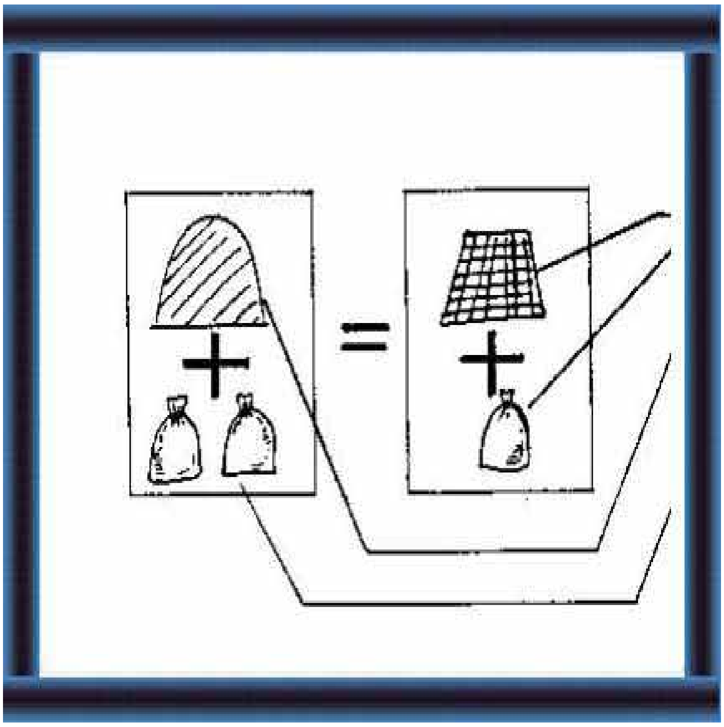


15 Treated straw:
- has a **higher feed value**
- makes a **cheaper** maintenance ration.

Your animal eats more straw.

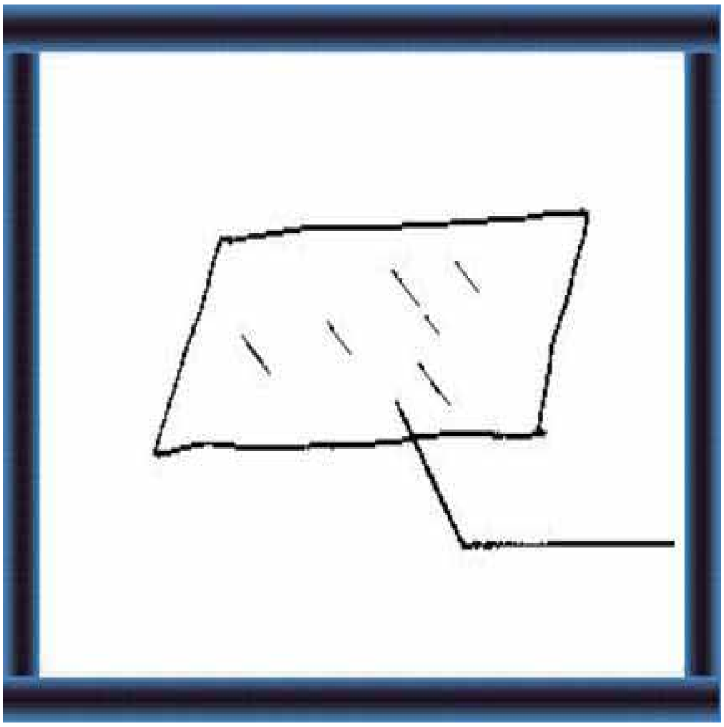


16 For young stock, treated straw supports **weight gain** and **growth better** than untreated straw.

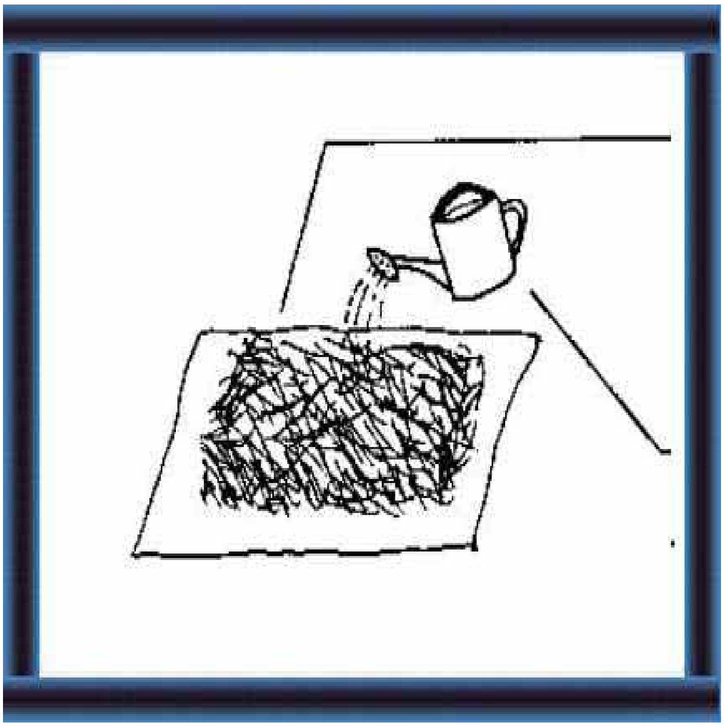


17 For the **same ration**, if you use **treated straw** you can use **less concentrates** for maintenance and the lower levels of milk production. If you use **untreated straw** you must use **more concentrates**. Using treated straw **saves you money**.

How can you treat straw?

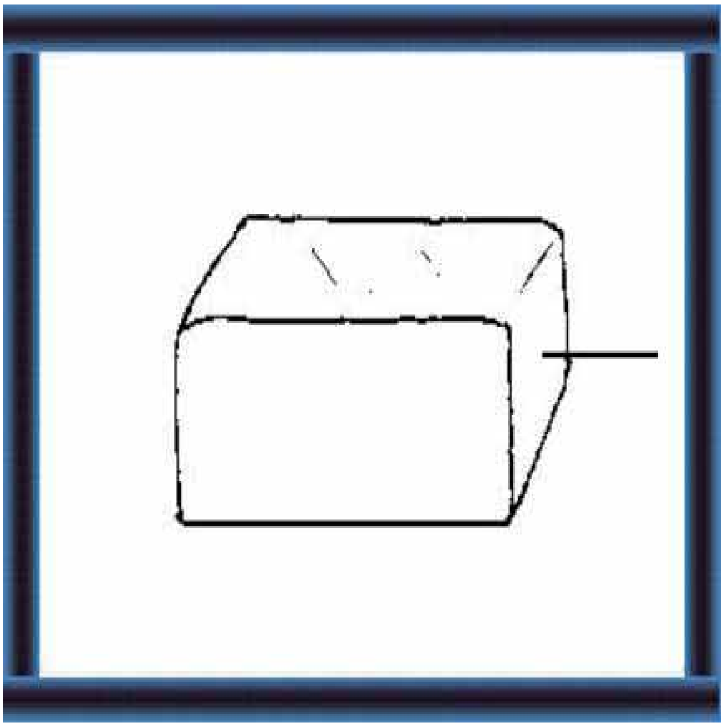


18 You can use a **temporary site** or a **permanent structure** for straw treatment.
If you use a temporary site follow these steps:
- lay down a **plastic sheet**

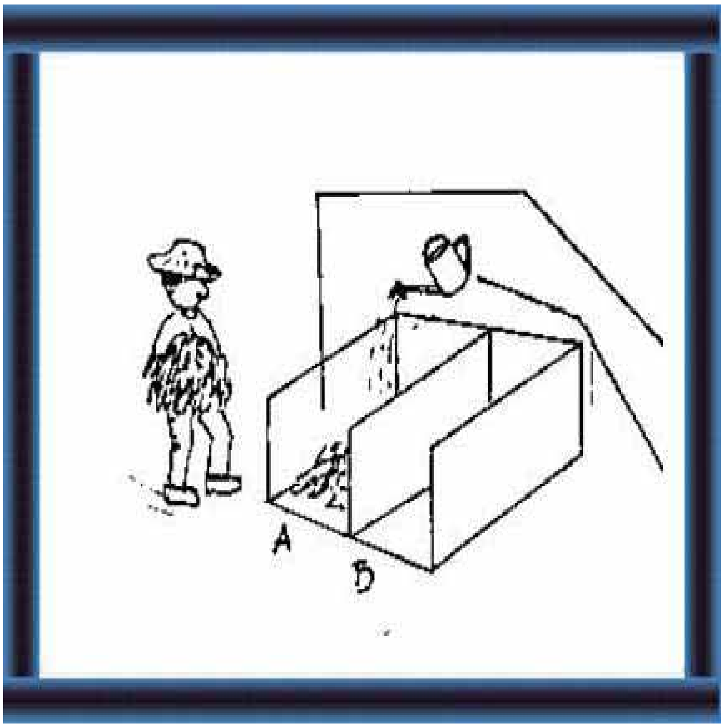


19
- **spread straw** on the sheet and sprinkle with **urea mixture**

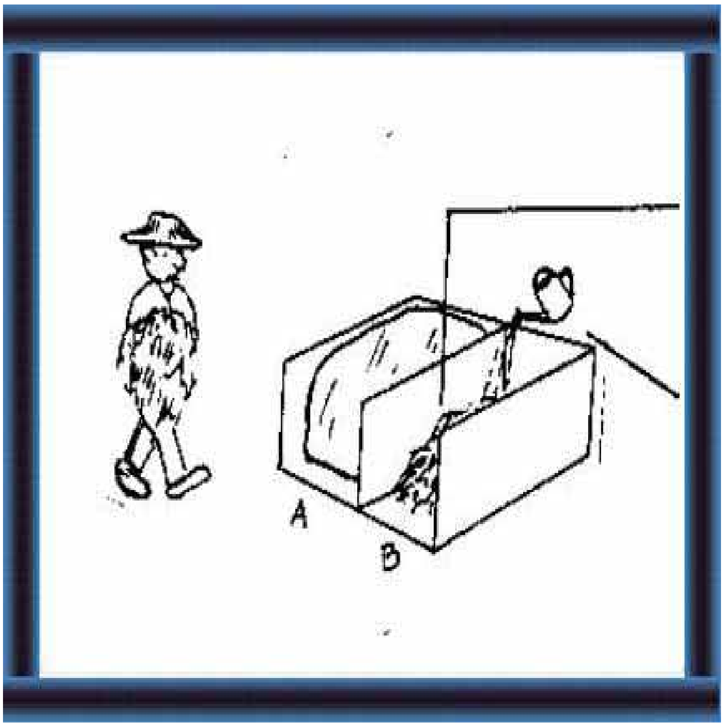
20
- **repeat** the step in 19 a number of times



21
- **seal** the stack with a **plastic sheet**.

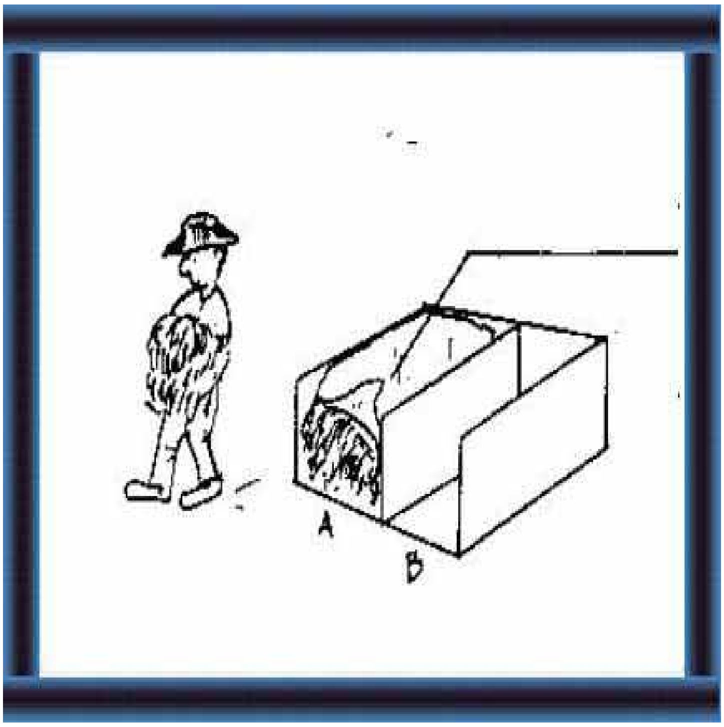


22 If you **regularly** use treated straw, make **2 chambers** and:
Week 1:
Fill chamber A by adding a layer of straw and sprinkling with urea (see 19).



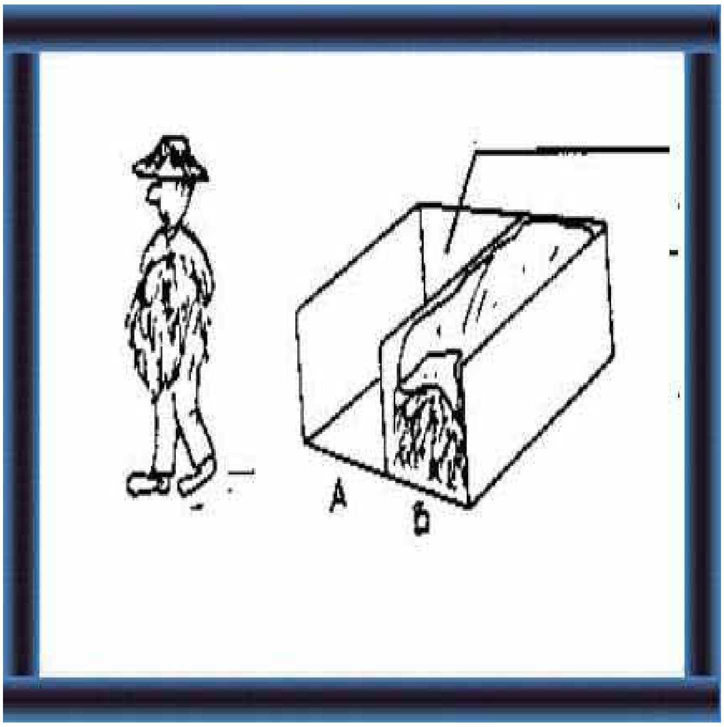
23 **Week 2**:

Start **filling** chamber B with straw and **treating** in the same way as for chamber A.

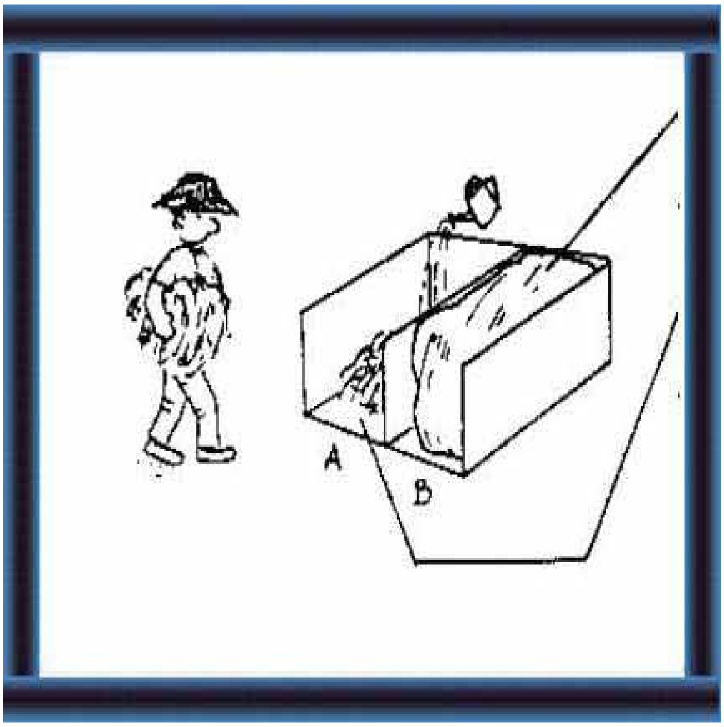


24 **Week 4**:

Start feeding from chamber A at the beginning of Week 4.



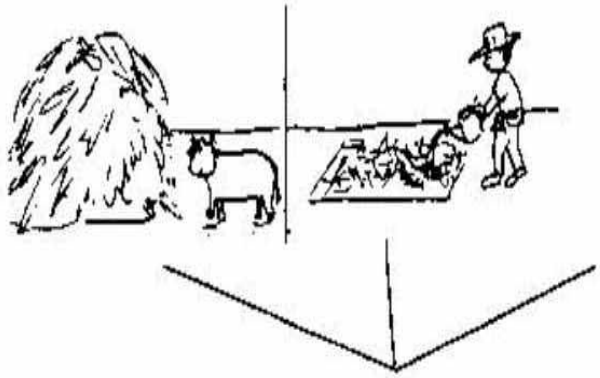
25 **Week 7**:
When chamber A is **empty**, **start feeding** from chamber B.



26 While feeding from chamber B, start filling and treating chamber A again and **repeat** the process.

Important

Try to leave your straw for 3 weeks in either chamber before feeding. Therefore, each chamber should hold 3 weeks feed.

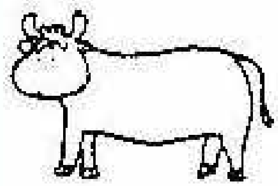
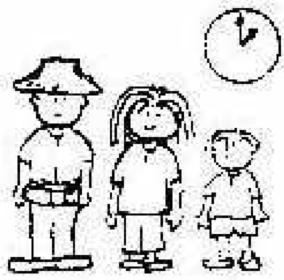


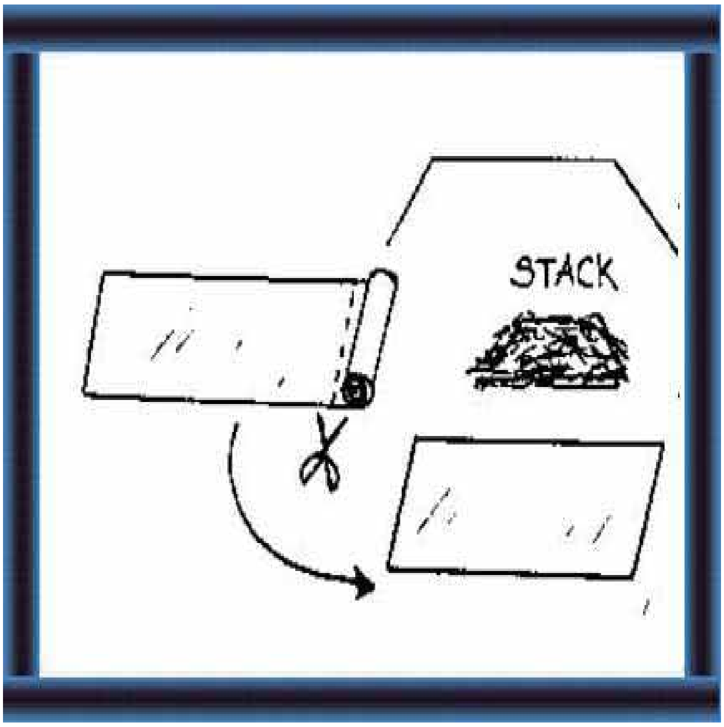
How big should your stack be?

27 Make enough treated straw for **3-4 weeks of feeding**.

You need **more** treated straw if you have **more** animals.
If your feeding period is **longer** than 3-4 weeks, make **two or more medium-sized stacks** rather than one large stack.

28 **How can you calculate the amounts of straw and labour?**

Number of Cows Feeding 	Amount of Untreated Straw (each cow eating 6 kg of treated straw per day) 	Stack Area (m^2) 	Hours the Farmers have to Work 
2	400	5.00 x 1.80	2
4	750	6.00 x 2.80	4
8	1,500	2 x (6.00 x 2.80)	8



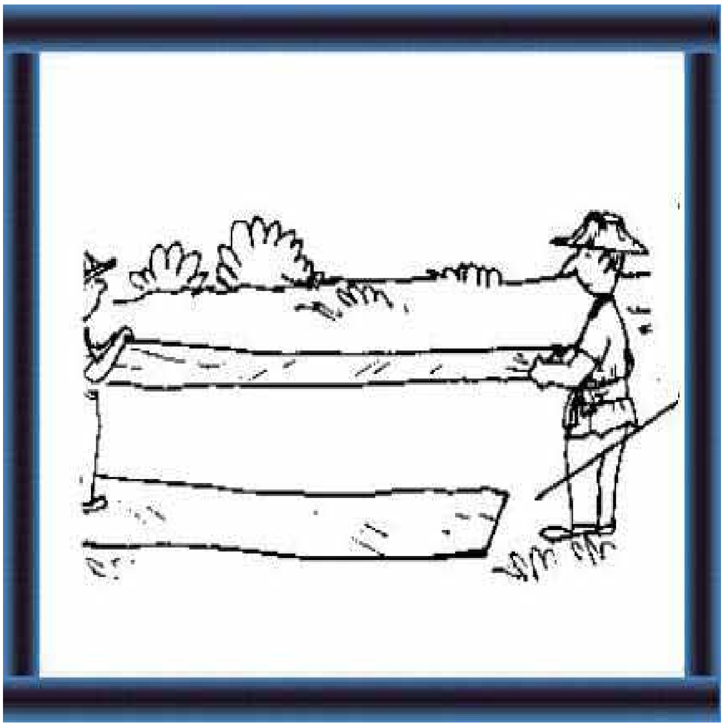
29 **Cover with airtight plastic cover.**

Buy rolls of plastic and cut in lengths **longer** and **wider** than the stack.
Then you can "**envelope**" the stack after treatment.

30 **How many metres of plastic sheet do you need?**

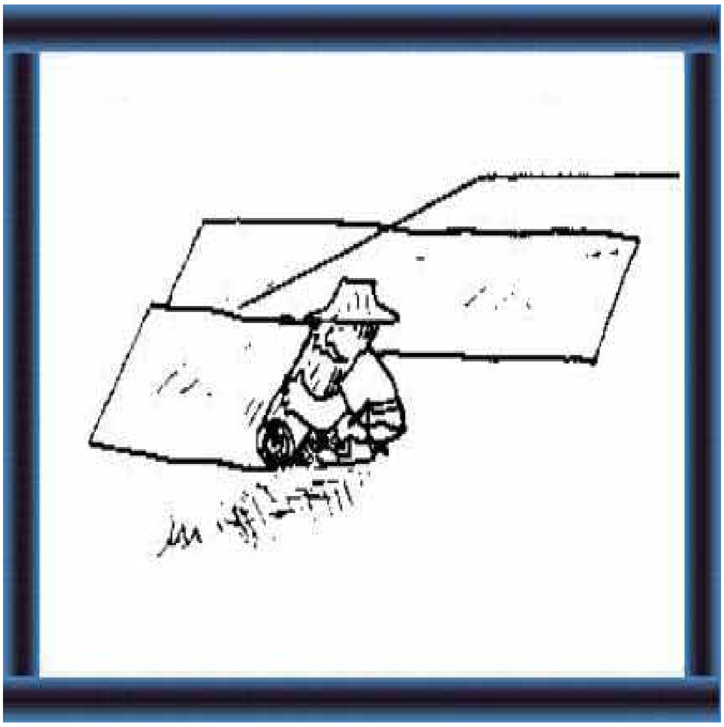
Stack Size (m)	Ground Sheet (m)	Cover Sheet (m)	Total Length of Plastic Sheet (m)
5.00 x 1.80 x 0.80	3 x 6.20 x 1.20	6 x 4.00 x 1.20	43
6.00 x 2.80 x 0.80	4 x 7.20 x 1.20	8 x 5.00 x 1.20	69
2 x 6.00 x 2.80 x 0.80	8 x 7.20 x 1.20	16 x 5.00 x 1.20	138

Straw treatment in detail



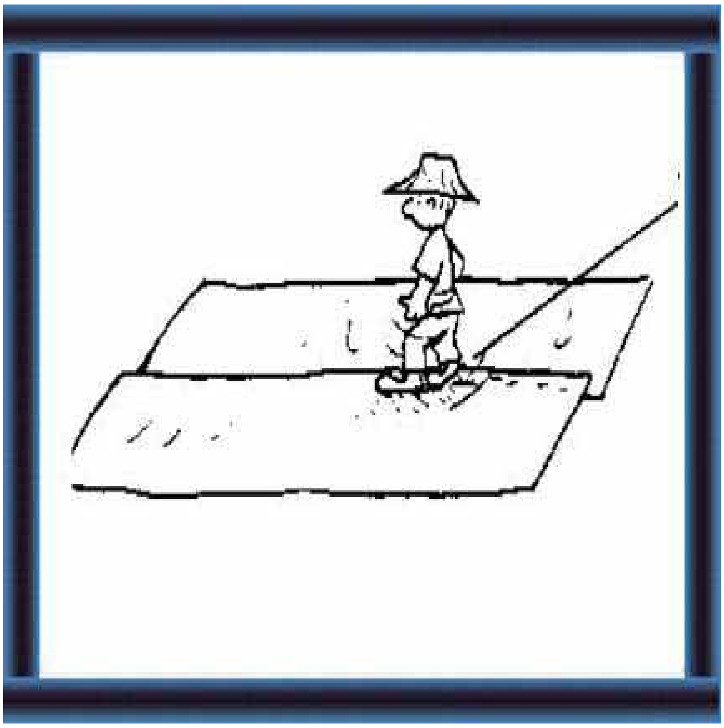
Step 1
31 Choose a site with **even ground**.

This could be the threshing place or a place close to the cow shed.



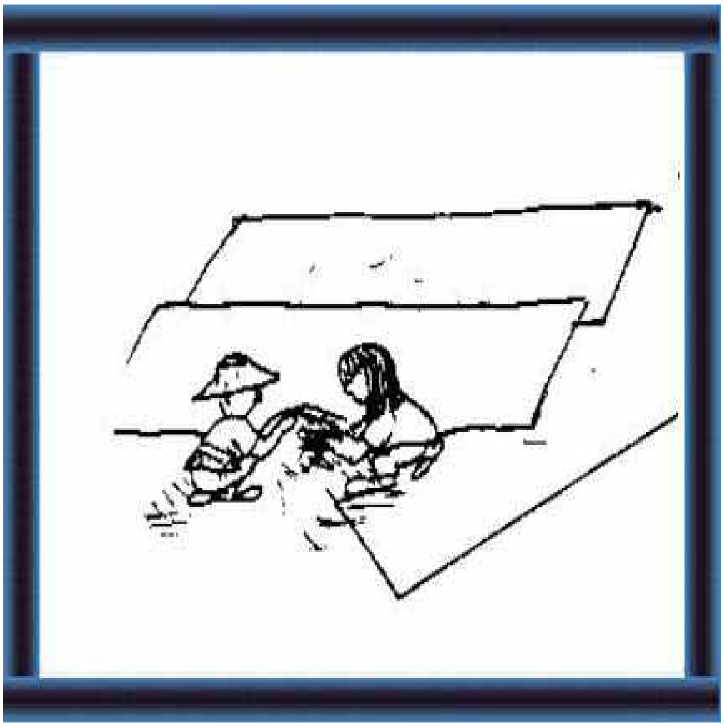
32 **Overlap** the sheets on the ground.

This makes a **seal** against the floor surface.



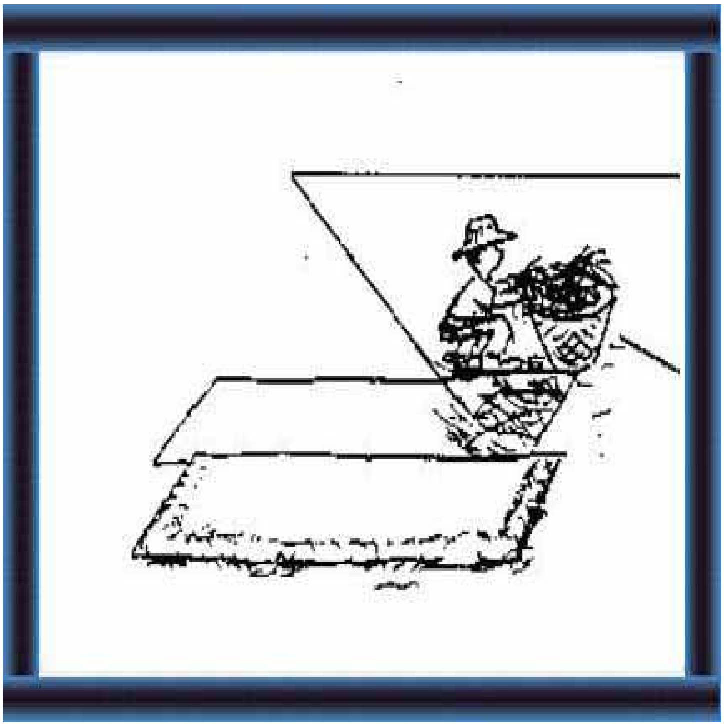
33 **Seal** the overlapping sheets together.

Simply **walk along** the places where the sheets overlap.



Step 2
34 **Lift** the edges of the plastic sheet and place loose straw **underneath**.

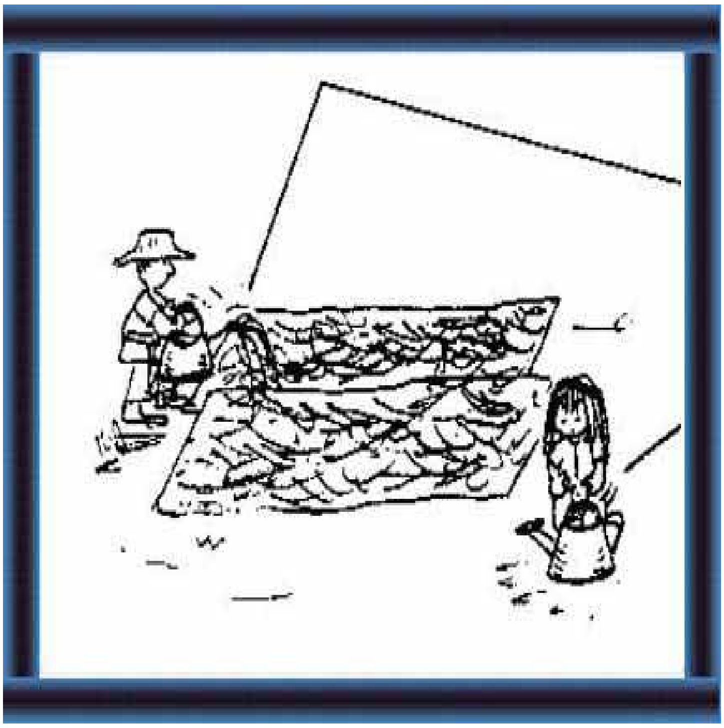
This keeps the **water/urea mixture in the stack**.



Step 3
35 **Spread** a **layer of straw** over the plastic bottom **10-20 cm high.**

50 kg of straw is **easy to handle** at one time.

Use **large baskets** to measure and transport the straw.

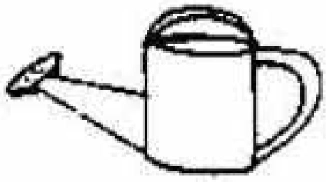
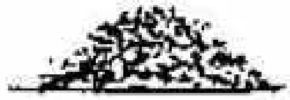


Step 4
36 Sprinkle **40 kg of water** over the layer of straw.

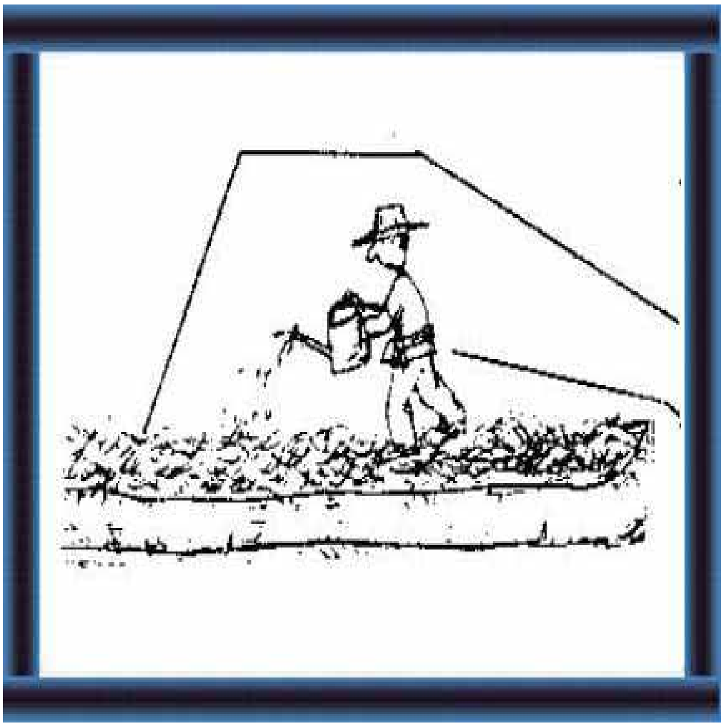
Mix the other **10 kg of water** with **3 kg of urea** and **stir well**.

Sprinkle this mixture over the **same layer** of straw.

37 How much water and urea do you need for treating different amounts of straw?

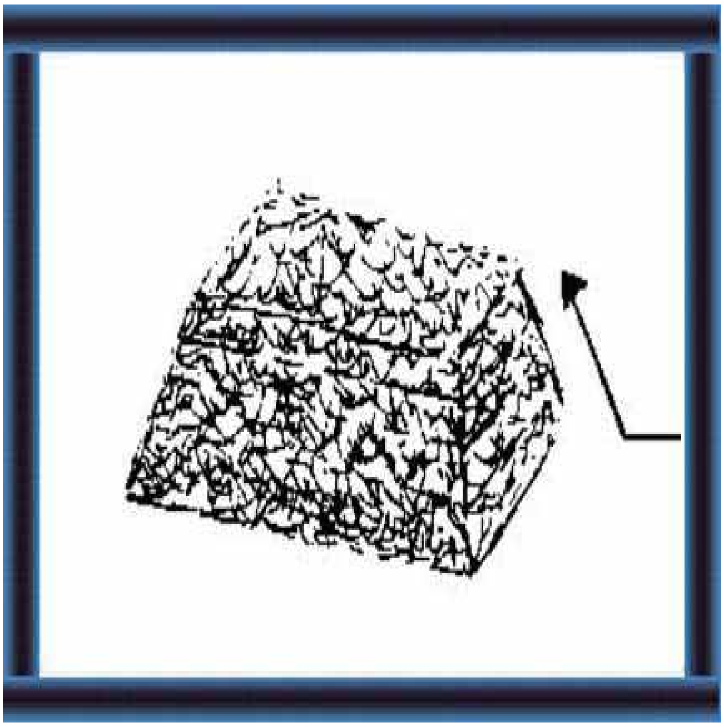
Untreated Straw (kg)	Water (l)	Urea (kg)
		
400	400	24
750	750	45
1,500	1,500	90

Step 3 and Step 4 repeated
38 Add a **new layer** of 50 kg of straw (Step 3).

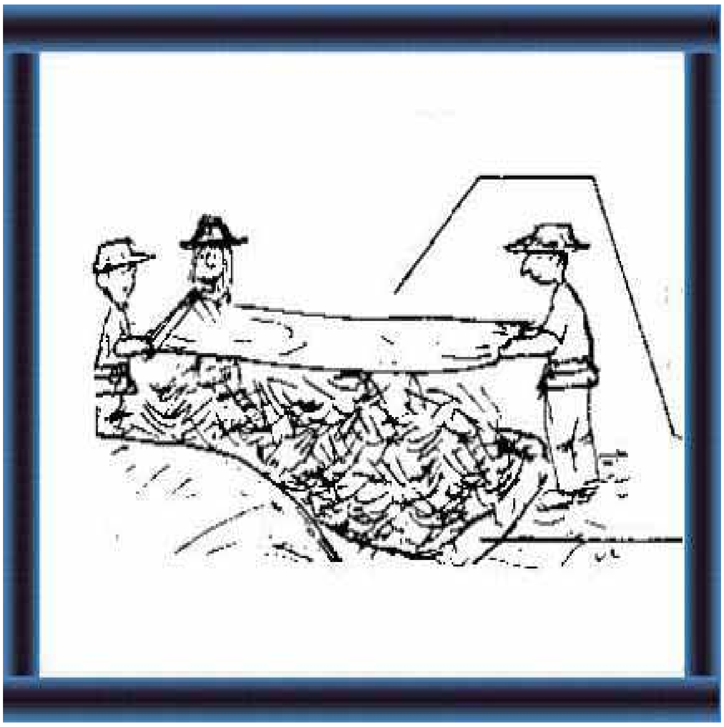


Treat in the same way with water and urea (Step 4).

39 **Repeat these steps** until you have **enough** straw to feed your milking animals for 3-4 weeks.

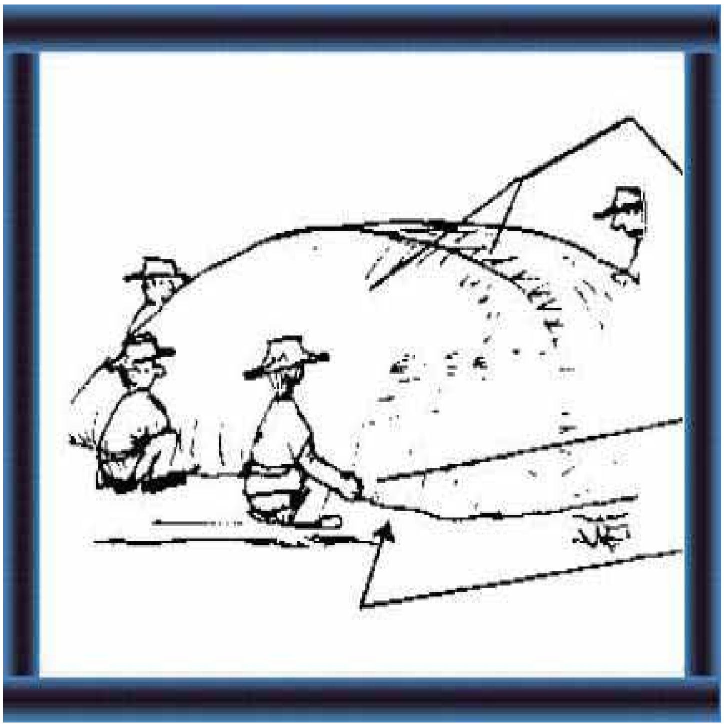


40 As you add **more** layers, gradually **narrow** the stack.



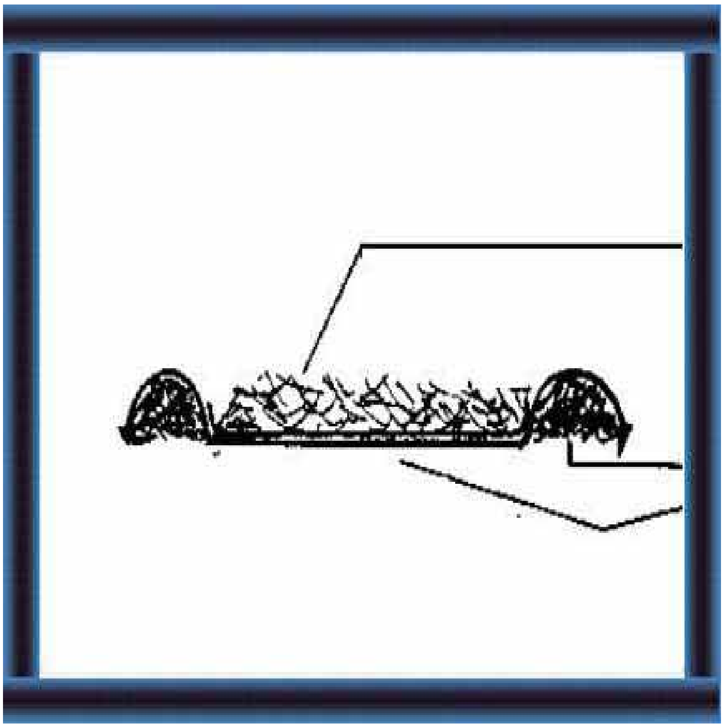
Step 5

41 **Carefully seal** the stack with a plastic top sheet and a plastic ground sheet.



42 **Cover** the **top** and the **sides** with plastic sheets.

Fold these sheets at the bottom and **push them under** the ground sheet.



Here are the main steps again:
43 **Stack begun**

First layer of straw

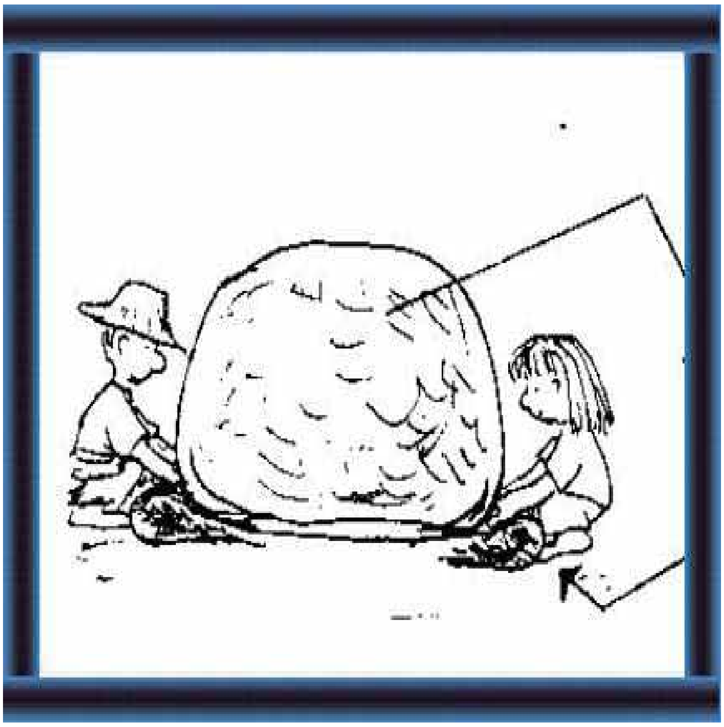
Plastic ground sheet (rolled)

Straw packed to form wall

Plastic ground sheet (flat)

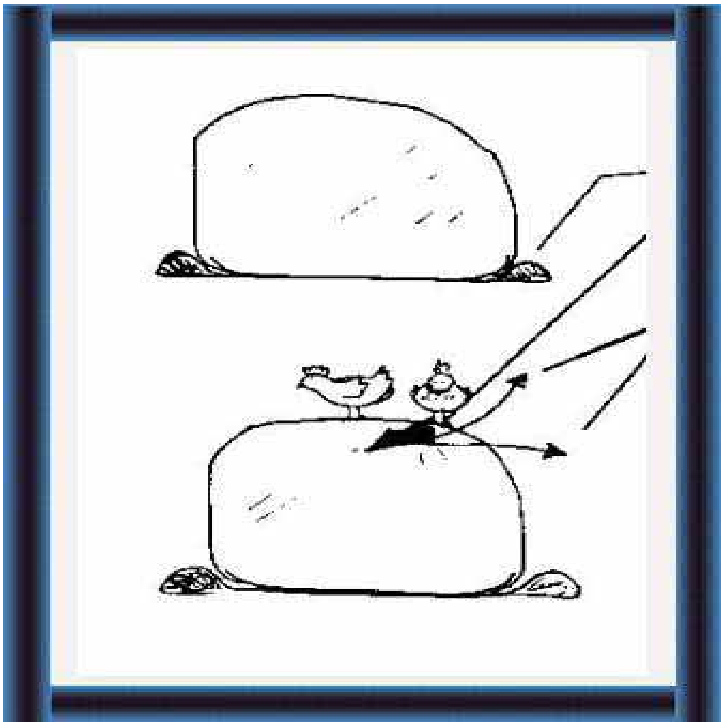
44 **Stack completed**

Edge of ground sheet showing.



45 **Stack sealed**

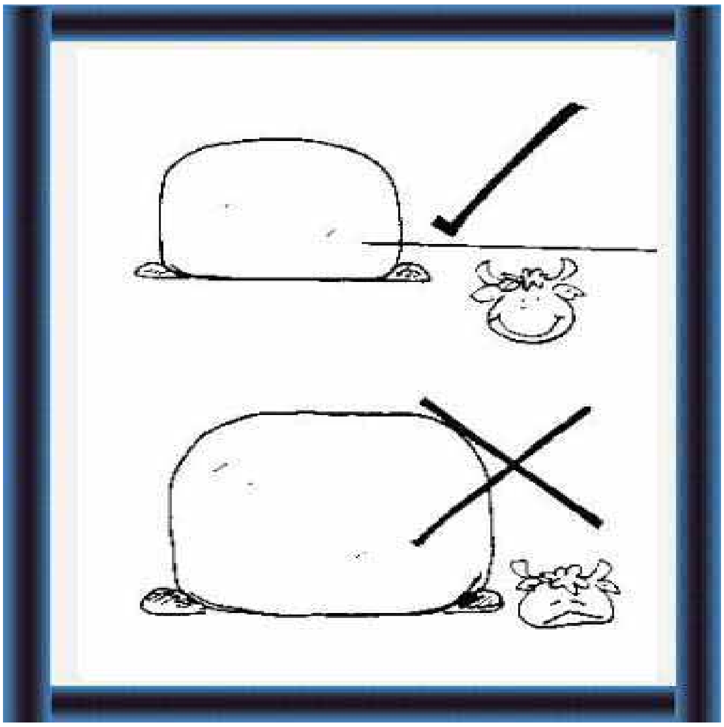
Top sheet folded and pushed **under ground sheet**.



And some more important points:
46 Seals must be **airtight**.

Keep the **ammonia in** the **stack**.

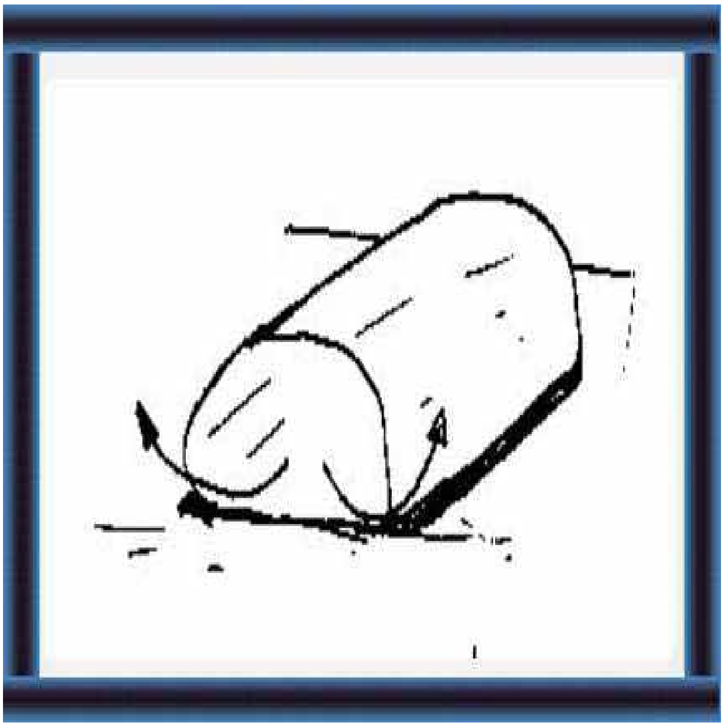
If the plastic jacket is **damaged**, for example by your chickens, **ammonia** will **escape**.



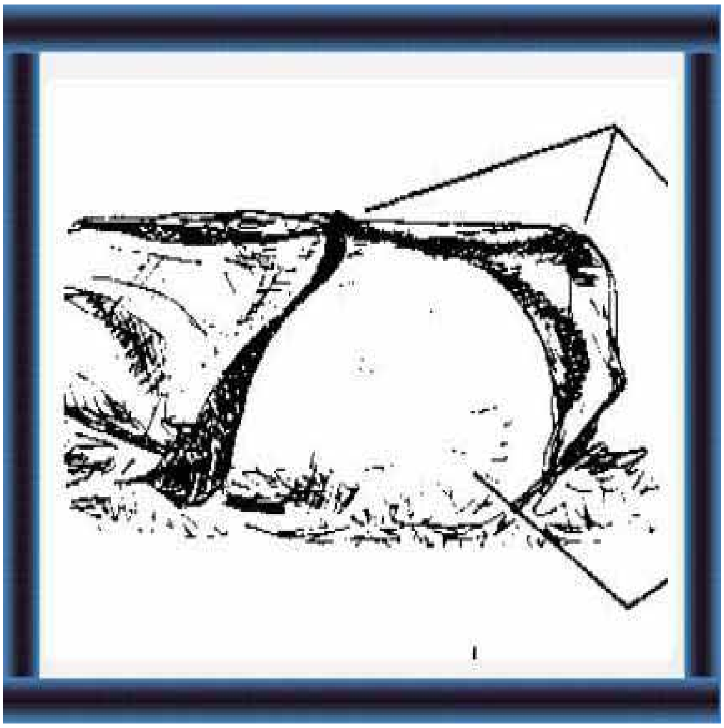
47 **How much** straw should you treat at one time?

If you keep treated straw for a **long time** in a **big** stack, it **loses feed value**, a **medium-sized** stack is **better**.

How can you use treated straw for feeding?



48 Three weeks after treatment **remove straw** from the **small end** of the stack.



49 Lift the **protective layers** of gunny bags and straw and the plastic jacket.
Remove the **daily ration** of **straw**.

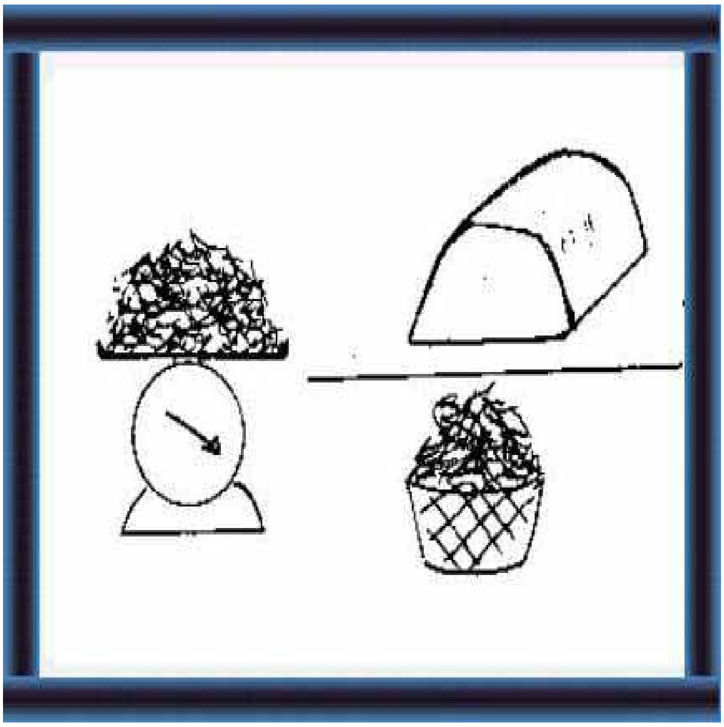
50 Remove the straw for the morning and evening feeding the **night before** and leave it overnight in the open air until feeding time.

This **takes away** the strong smell of **ammonia**.

51 **Carefully close the stack.**

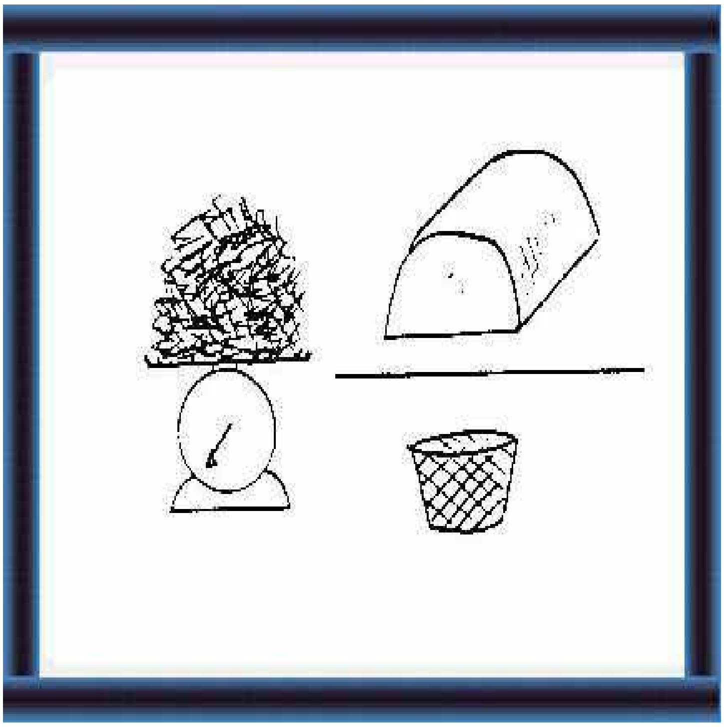
52 Treated straw for feeding should have a **mild** smell of ammonia.

53 If you **still** have some grass to feed.



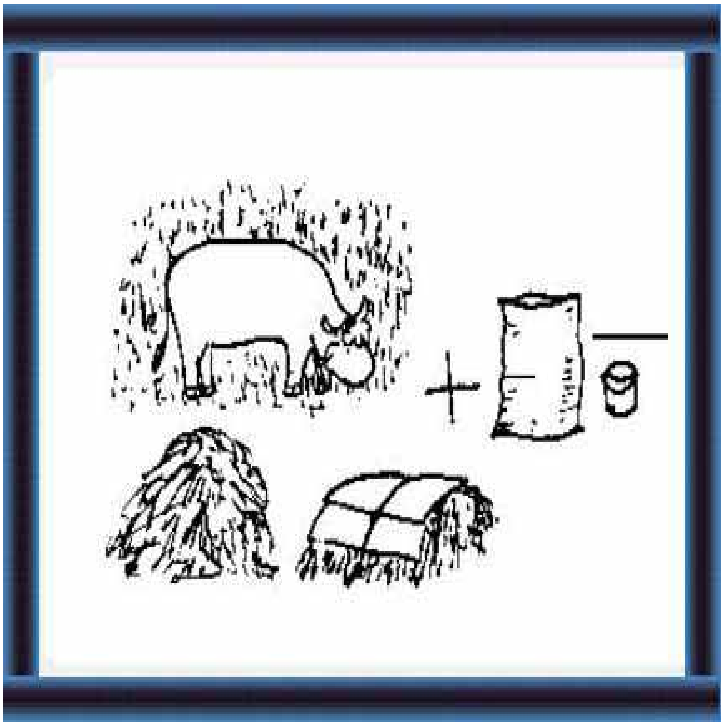
54 ... you can give **3 kg of treated straw** for each morning and evening feeding (= 6 kg/cow/day).

55 In the **dry season**, the amount of grass in the ration **decreases**



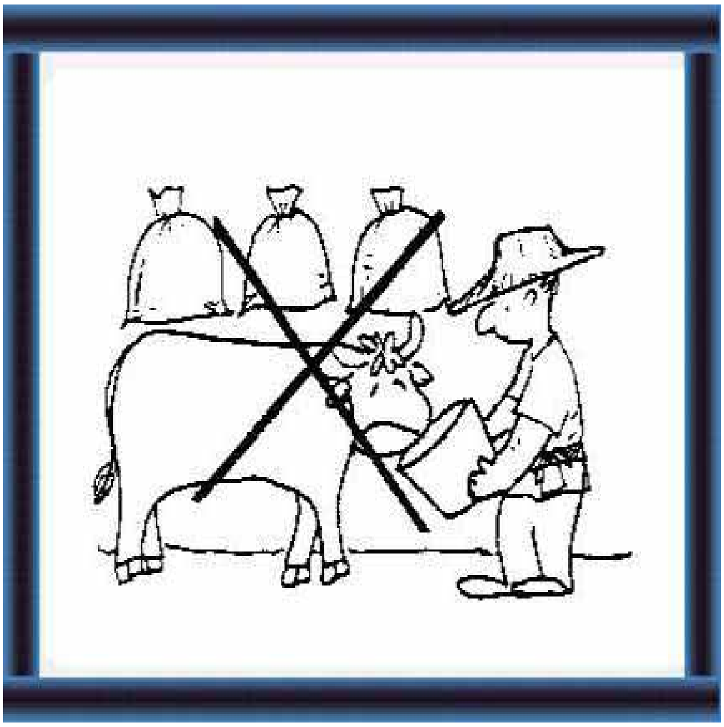
56 .... you must give **more** treated straw:

8, 10 or even 12 kg per cow per day.



57 Supplement your rations of grass and treated straw with **concentrates**.

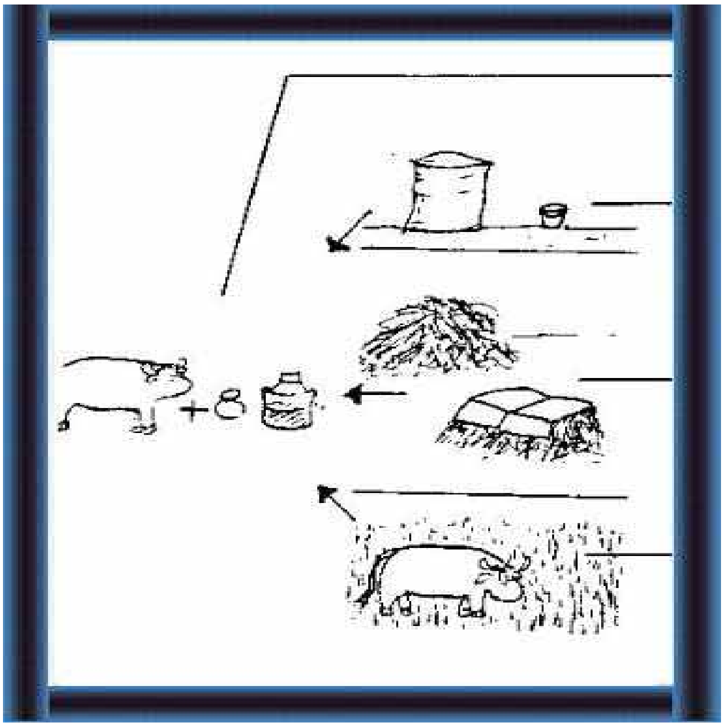
Your extension worker can advise you on quantities.



58 Do not feed more concentrates than necessary.

Your cow **cannot digest** the straw properly.

59 Keep concentrates to **25% or less** of the **total ration**.



60 For example, the ration of **maintenance + 8 kg milk yield** should include about:
- **22% concentrates** (about 4 kg/day)
- **48% treated straw** (about 9 kg/day)
- **30% grass** (about 6 kg/day)

61 If your rations contain a **lot of rice straw**, you must supplement with **minerals**:
- calcium
- phosphorus
- micro-elements.

Ask your extension worker for mineral blocks.

What do you know about treated straw?

Reasons for treating straw

1 Make good use of left-over straw	(5-6)
2 Straw treated with urea has higher feed value	(7)
3 Treated straw is easy to make and requires little labour	(8-11)
4 Feeding urea alone can be toxic	(12-13)

Cost of feeding treated straw

You save money because:	
1 Your animals grow better	(14-16)
2 You use less concentrates	(17)

Chamber method (22-26)

Materials as for Stack method with two chambers	
Method of treating straw	
Stack method	(3, 18-21)
1 Materials:	
- plastic sheet	
- straw	
- urea	
- watering can and water	
2 Calculating:	
- straw	(28)
- labour	(28)
- plastic sheet	(30)
- water/urea	(37)
3 Operations:	
- laying sheet	(18,29,31-34)
- alternate straw and urea mixture	(19-20,35-40)
- sealing	(21,33,41-42,46)
- leaving for 3 weeks	

Feeding treated straw

1 Preparation:	
- removal from stack	(48-50)
- resealing	(52)
- timing	(51)
2 Feeding:	
- with grass	(54-58)

Small-Scale

Dairy Farming Manual

Volume 3

Husbandry Unit 5.6

CONCENTRATES

CONCENTRATES

Husbandry Unit 5.6:

Technical Notes

Note: Numbers in brackets refer to illustrations in the Extension Materials.

Concentrates are a group of livestock feeds which are characterised by a higher dry matter content and a higher digestibility than roughages such as the stems and leaves of the grasses, fodders, legumes and trees. (1)

Concentrates of plant origin can be either energy-rich concentrates or protein-rich concentrates.

Energy-rich concentrates: dried cassava tubers; cereals such as rice, wheat, maize, millet and sorghum; agricultural by-products such as rice bran, wheat bran, molasses (2)

Protein-rich concentrates: coconut cake; soybean meal; palm kernel cake; sunflower cake; groundnut (peanut) cake; cotton seed cake; rubber seed meal etc. (3)

Concentrates of animal origin are characterized by the larger amounts of high-quality proteins contained in them. Some examples are the by-products of the milk processing industry e.g. skim milk and whey which can be used in calf feeds. These are too expensive to be given to adult ruminants. (4)

Extension Materials

What are concentrates?

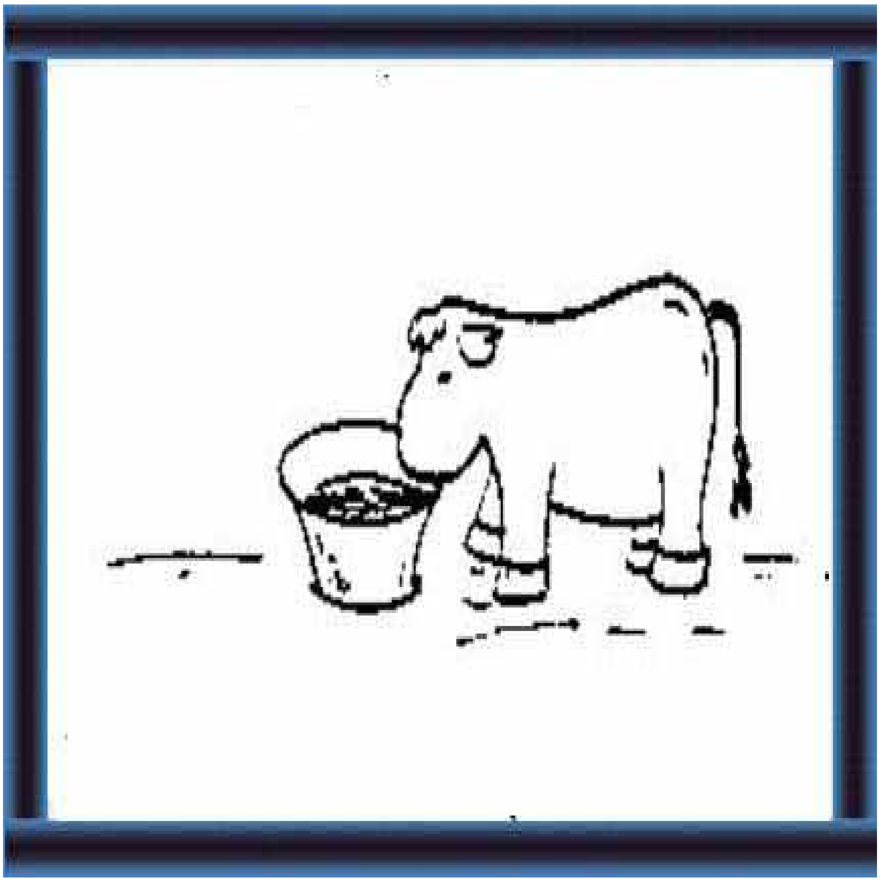
1 Animal feeds with **higher**:
- dry matter content
- digestibility

than roughages such as the stems and leaves of grasses, fodders, legumes and trees.

What types of concentrates are there?

2 Two types of concentrates come from **plants**:
Energy-rich concentrates e.g.
- dried cassava, tubers cereals such as rice, wheat
- by-products e.g. rice bran, molasses

3 **Protein-rich** concentrates e.g.
- coconut and sunflower cake
- soybean and rubbers seed meal



4 Concentrates from **animals** are rich in **high-quality** proteins e.g. by-products from skim milk and whey processing for calf feeds.

They are **too expensive** for **adult** animals.

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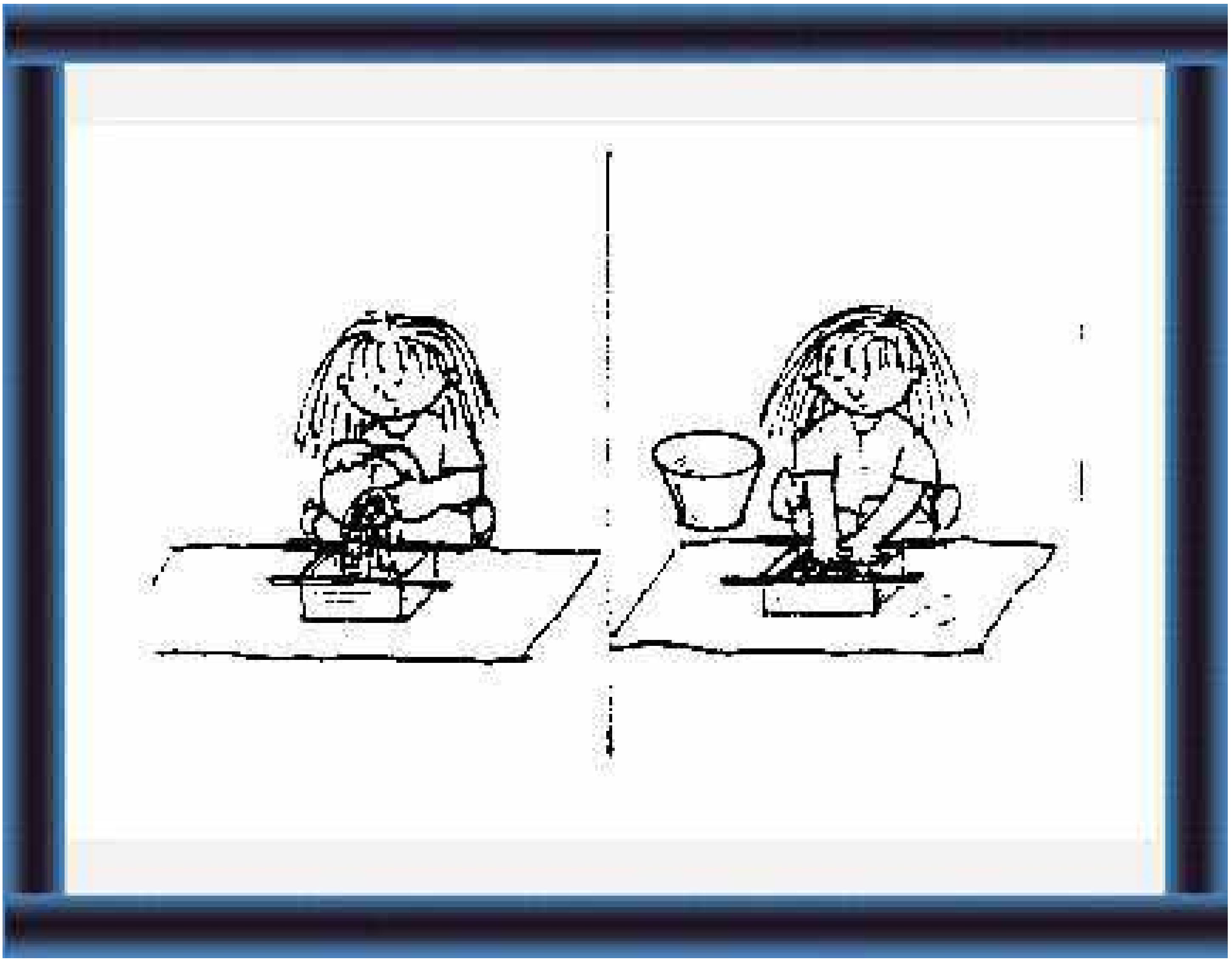
Dairy Farming Manual

Volume 3

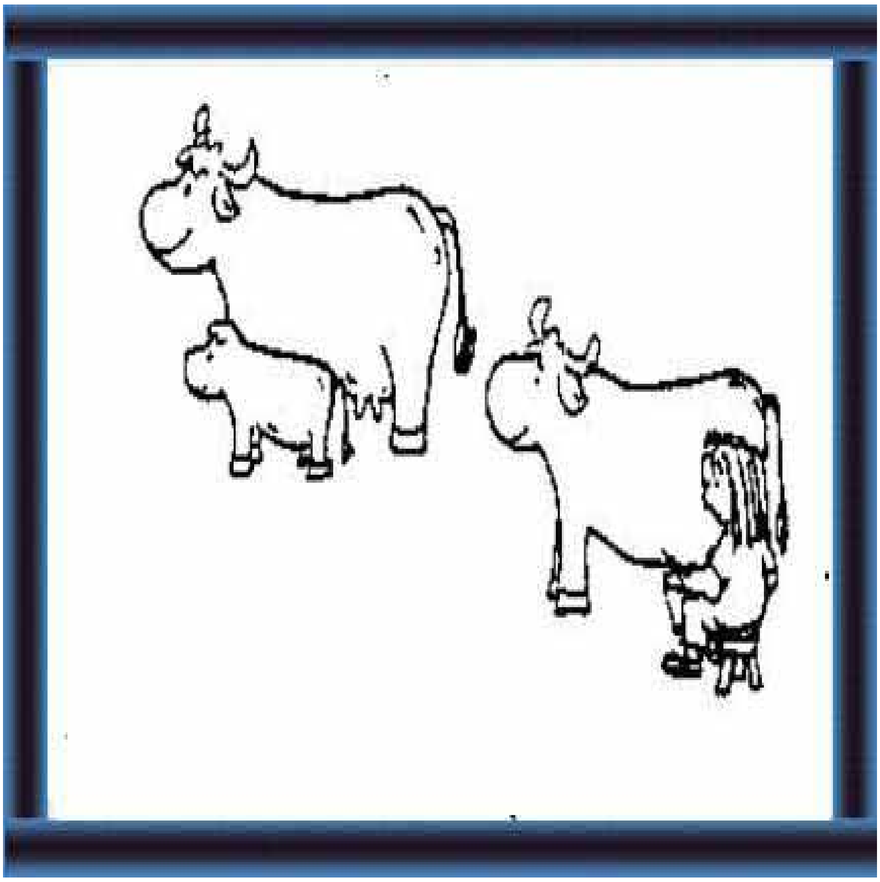
Husbandry Unit 5.7

MINERALS AND MINERAL BLOCK MAKING



Extension Materials

What should you know about minerals and mineral block making?

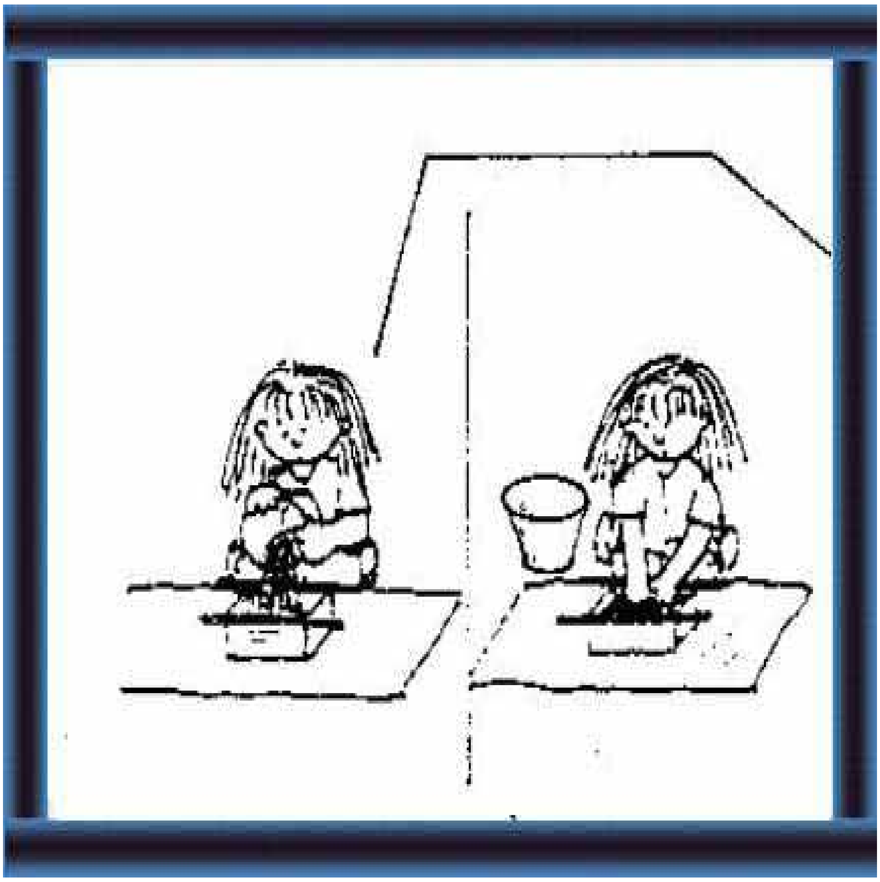


Why do your animals need minerals?(5-9)

1 For good
- health
- growth
- production.

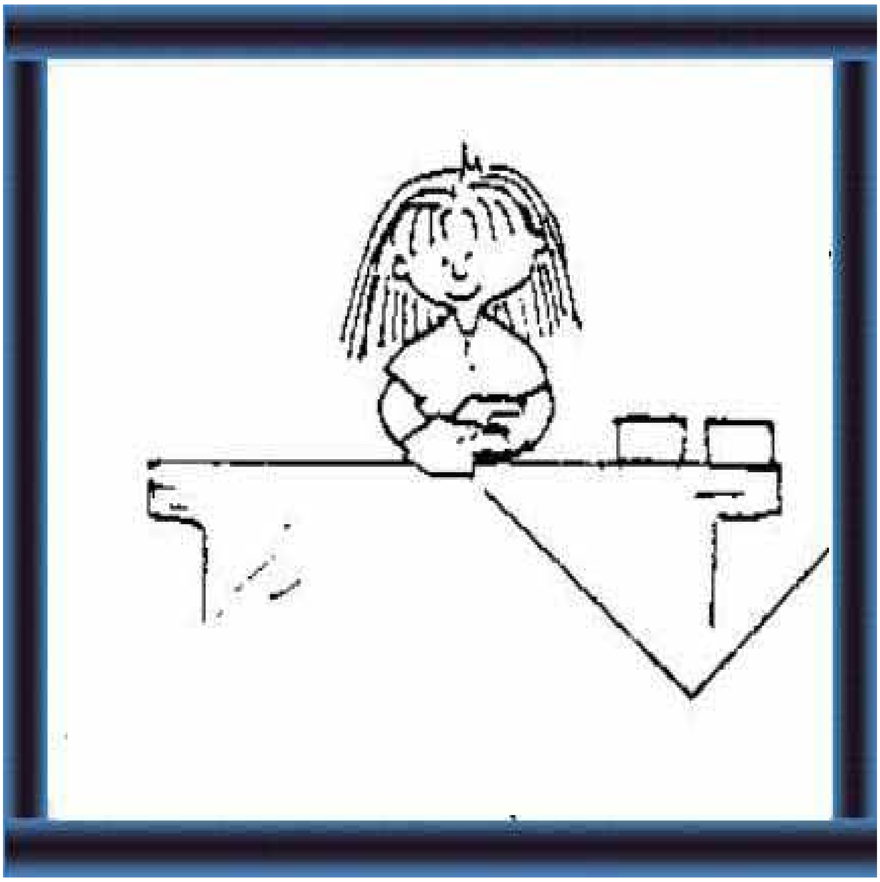
How can you feed minerals to your animals? (10-16)

2 By consulting your extension worker and using **mineral blocks**.



How can you make mineral blocks?(17-27)

3 By:
- using the **correct amounts** of materials
- **carefully preparing** the blocks.



How can you store mineral blocks? (28-29)

4 By:
- wrapping in **polythene**
- **keeping away** from **air** and **water**.

MINERALS AND MINERAL BLOCK MAKING

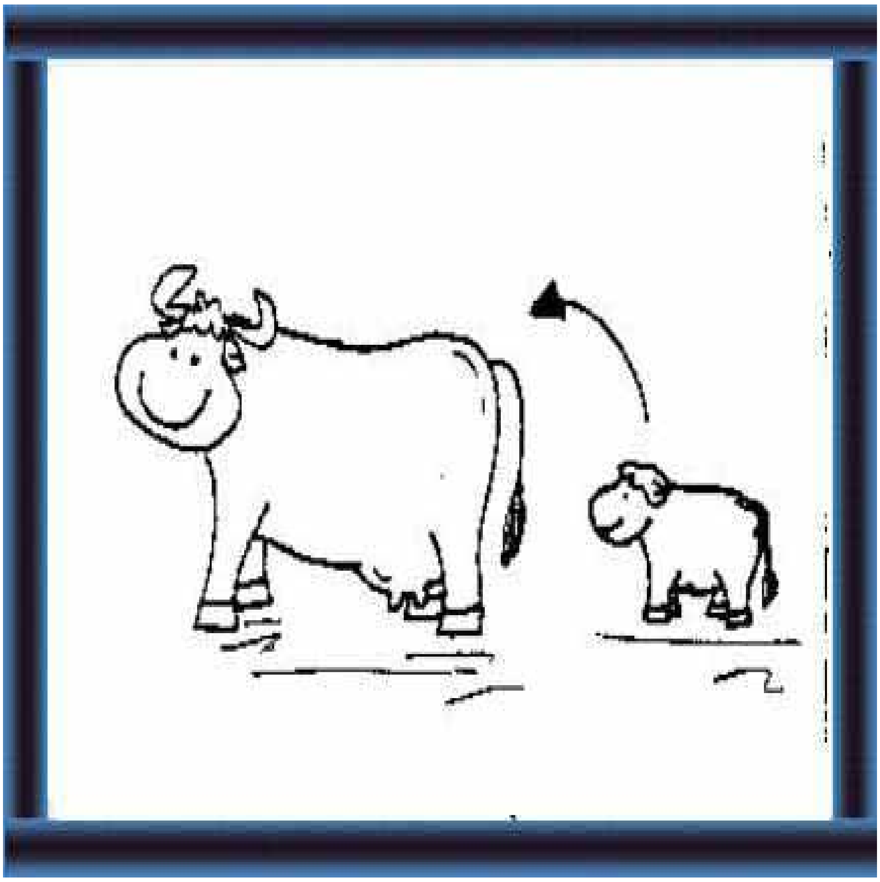
Husbandry Unit 5.7:

Technical Notes

Note: Numbers in brackets refer to illustrations in the Extension Materials.

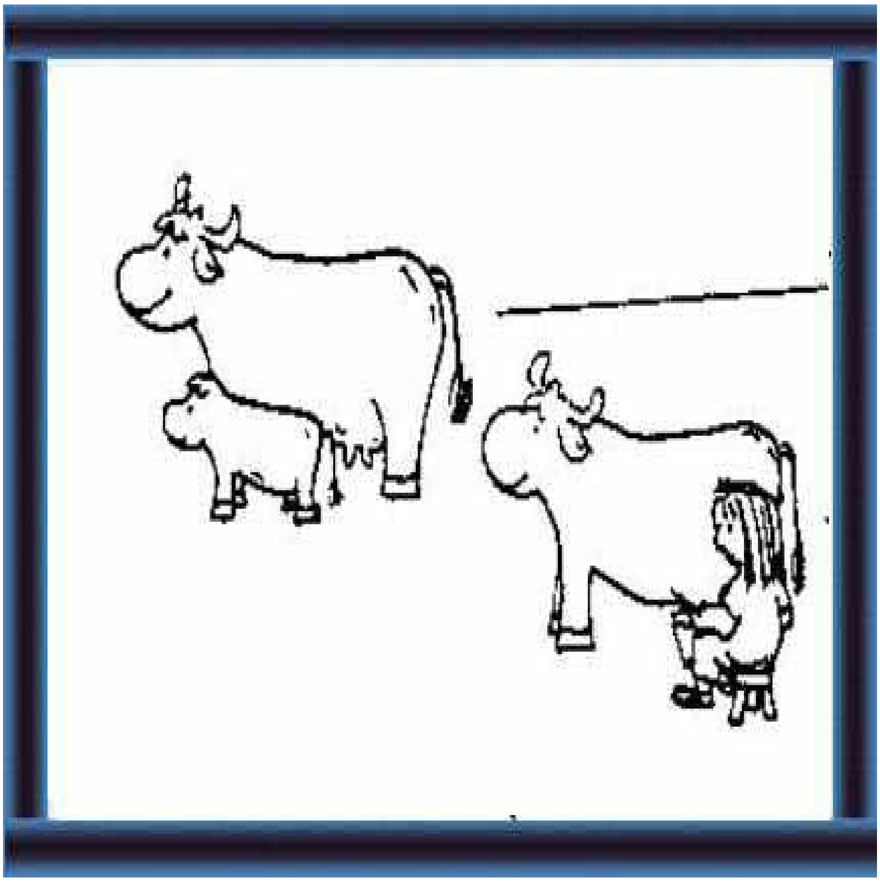
Minerals are an essential component in the diet of all animals. In dairy cattle and buffalo, minerals are required for the maintenance of general health and for proper growth and reproductive functions as well as to meet the quantities of minerals that are secreted in the milk. (5-6)

The quantities of minerals required vary with the type of mineral, type of animal and stage in the life cycle. Some animals may be able to obtain all the requirements of the minerals that they need from their normal diet. On the other hand, most animals may not show any obvious signs of a deficiency even if they do not receive adequate quantities of minerals. However, they will yet be susceptible to diseases, will not become pregnant in time and will have a slower growth and lower production than can be obtained, had they received an adequate supply of the required minerals. (7-9)

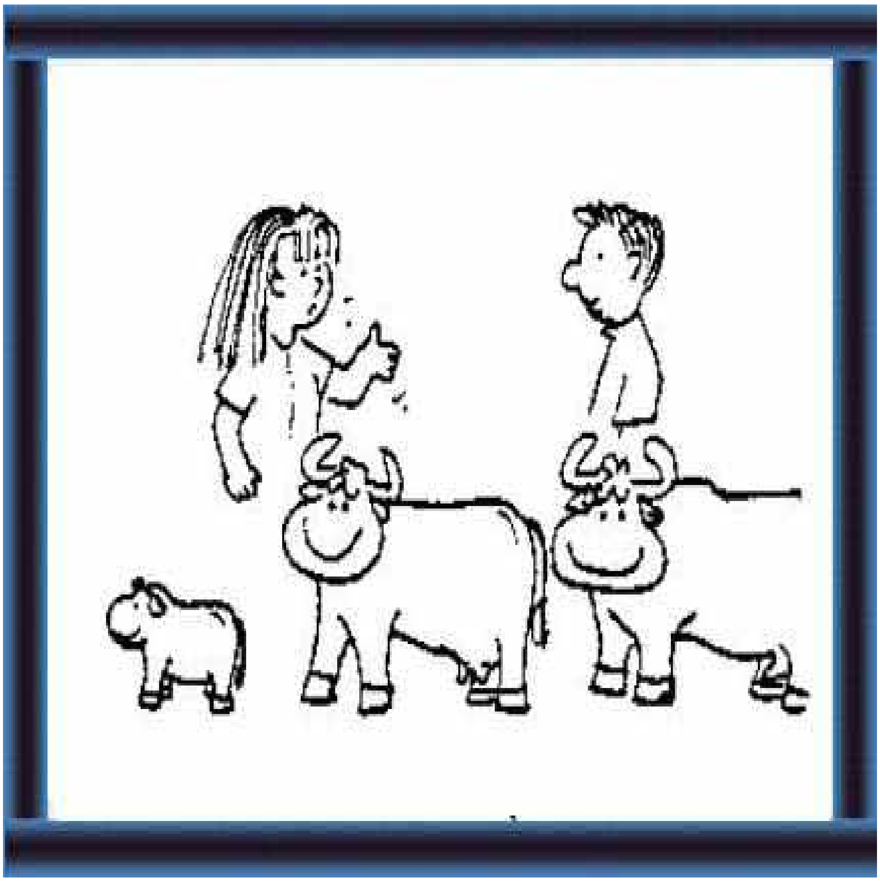


Why do your animals need minerals?

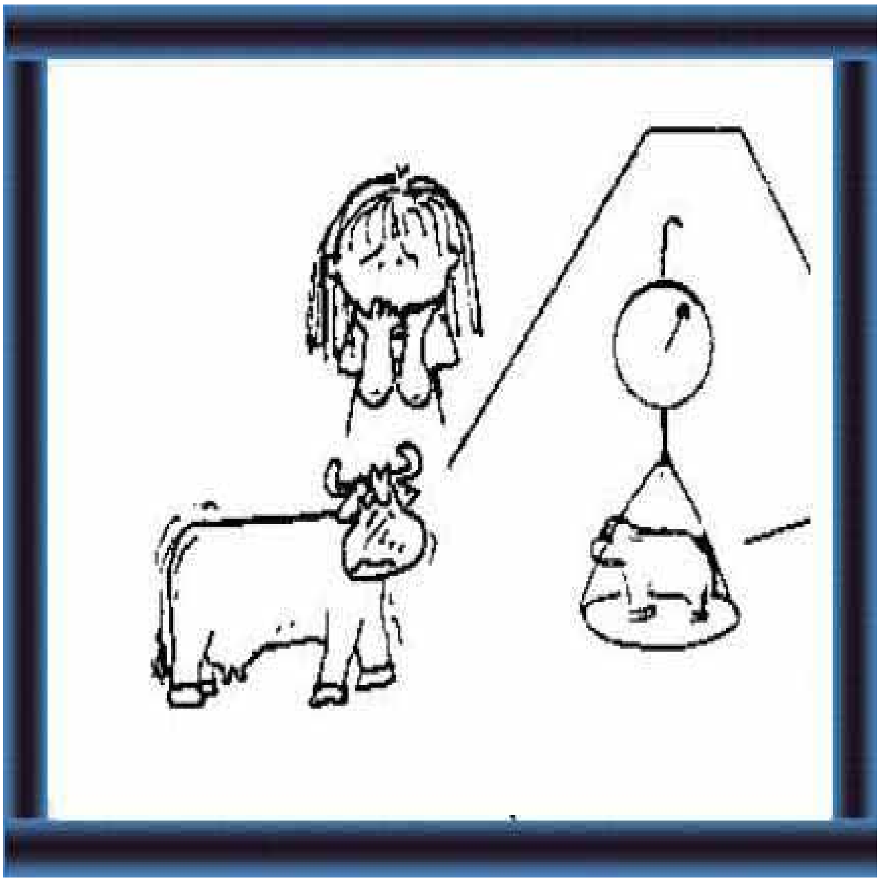
5 Dairy cattle and buffalo **need** minerals for:
- health
- growth



6
- reproduction
- milk production.

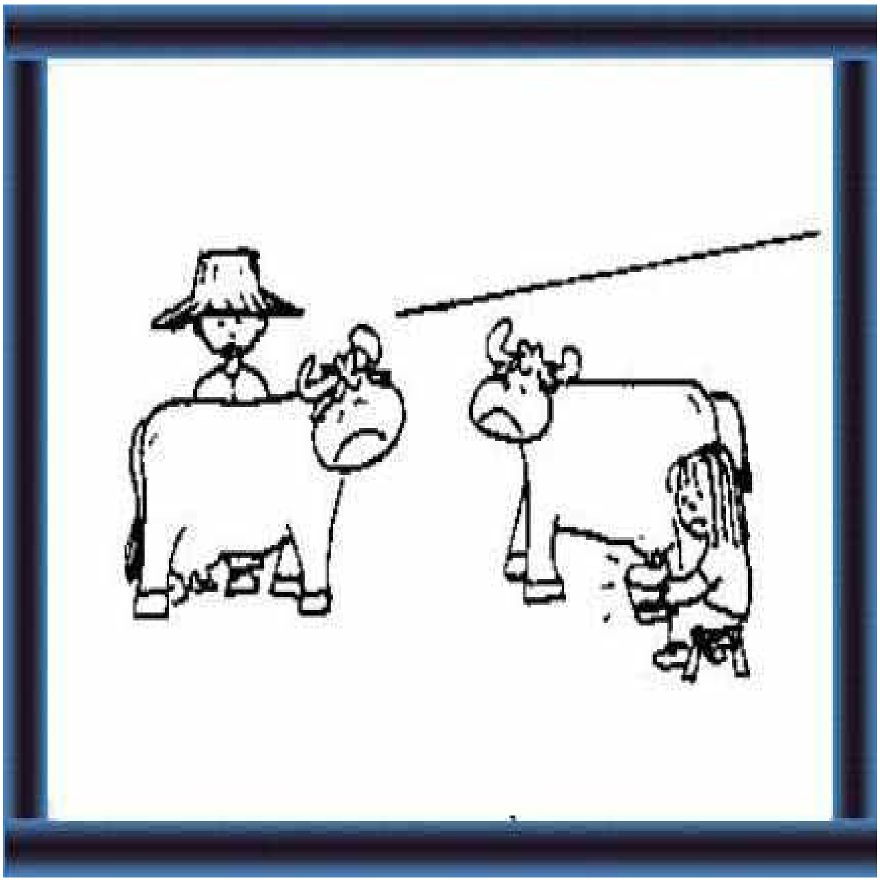


7 The **amounts** of minerals required depend upon:
- type of mineral
- type of animal
- age and use of animal.



8 If your animals do **not** have **enough** minerals, they may look normal **but** they will:
- get disease **more easily**
- grow **more slowly**

As the normal feeds offered to dairy cattle and buffalo may not contain the required amounts of minerals, additional quantities are usually supplied in the form of mineral supplements. The mineral supplements available in the market are produced to a standard formula and it may not be economical to feed such supplements under some conditions of feeding. In addition, there are considerable losses due to wastage when minerals are given to animals in the form of powders. (10-11)

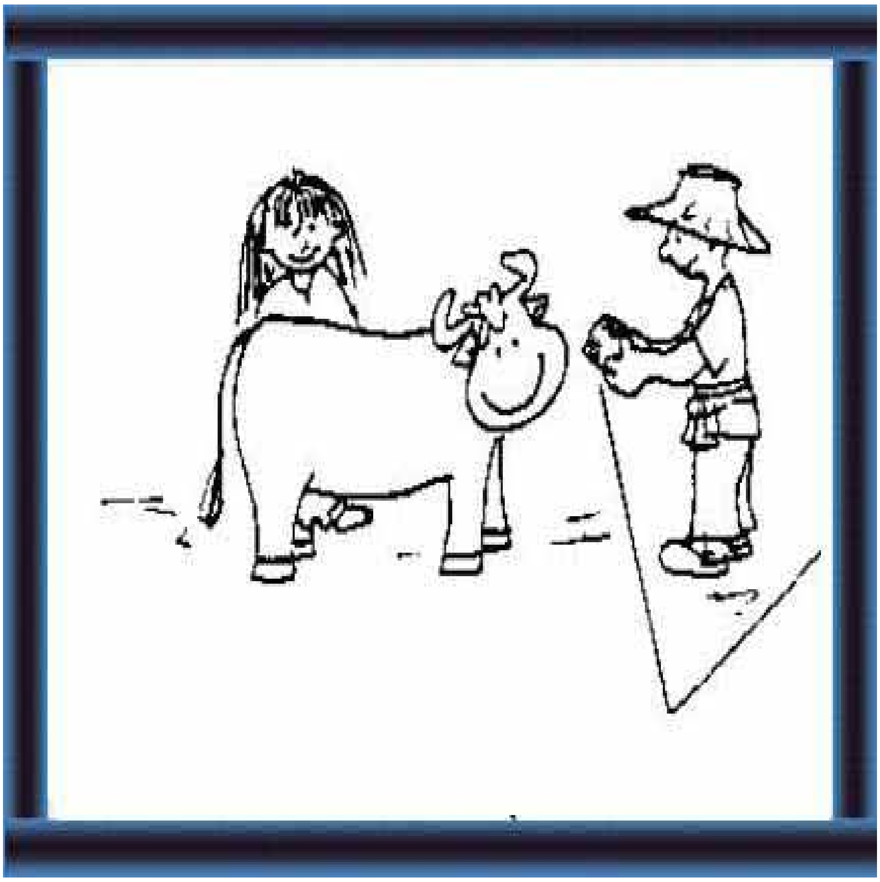


9
- get **pregnant late**
- have **low production**.

How can you feed minerals to your animals?

10 Normal feeds may **not** contain **enough minerals**:
- you need to give a **mineral supplement.**

11 **But**:
- commercial supplements are **expensive**
- powder supplements have a lot of **waste**.



12 It is better to use **mineral blocks**.

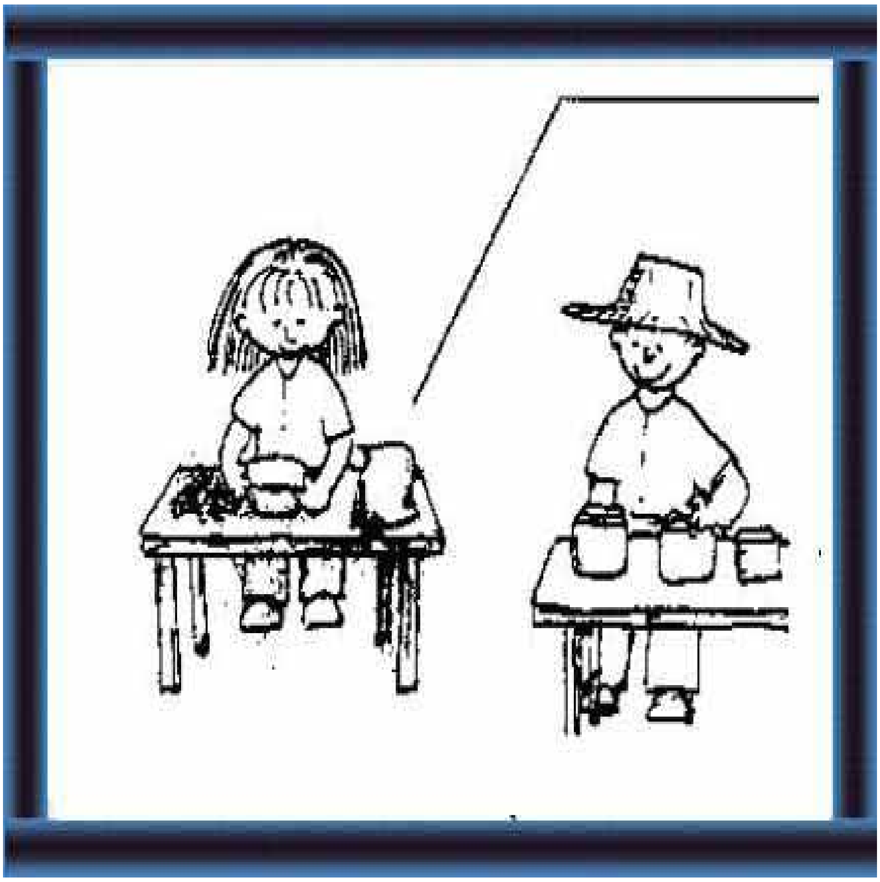
To avoid these difficulties, minerals can be offered in the form of blocks. The advantages of offering minerals in the form of blocks (over powders) are:

- farmers can themselves make blocks economically using components purchased from the market; (13)

- the composition of the blocks can be changed according to needs e.g. type of feeds available and quantities of minerals that animals can obtain from them; (14)

- the blocks can be left in the barn for the animals to obtain their requirements by licking;

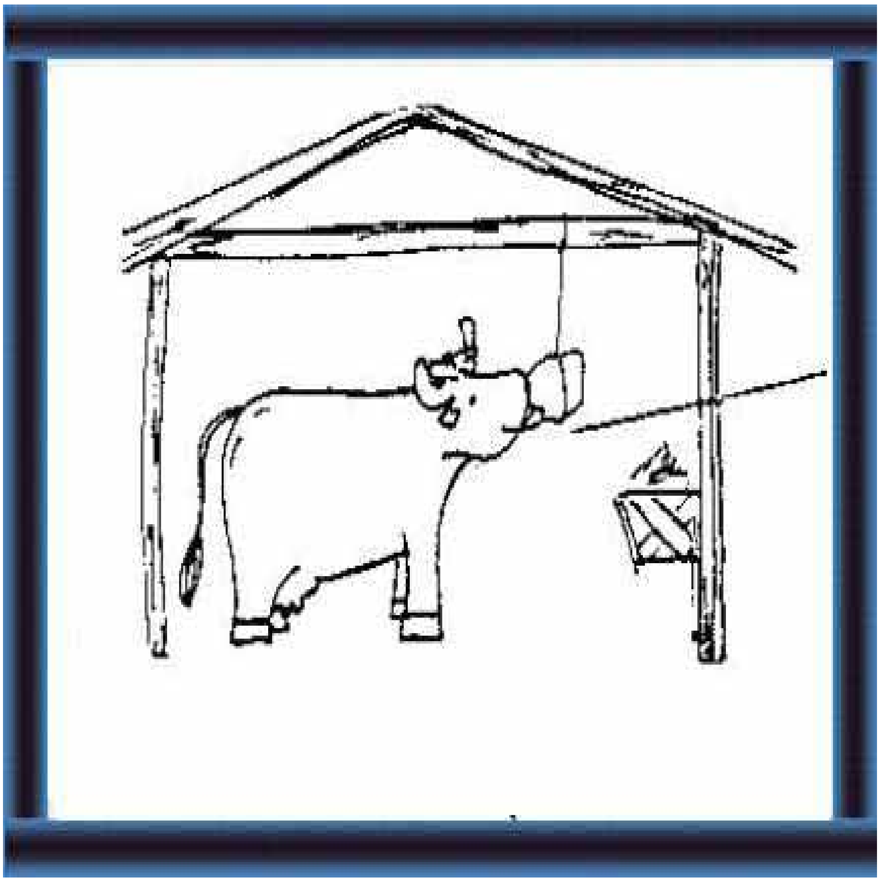
- there is less wastage, even when the blocks are left in the barn. (15)



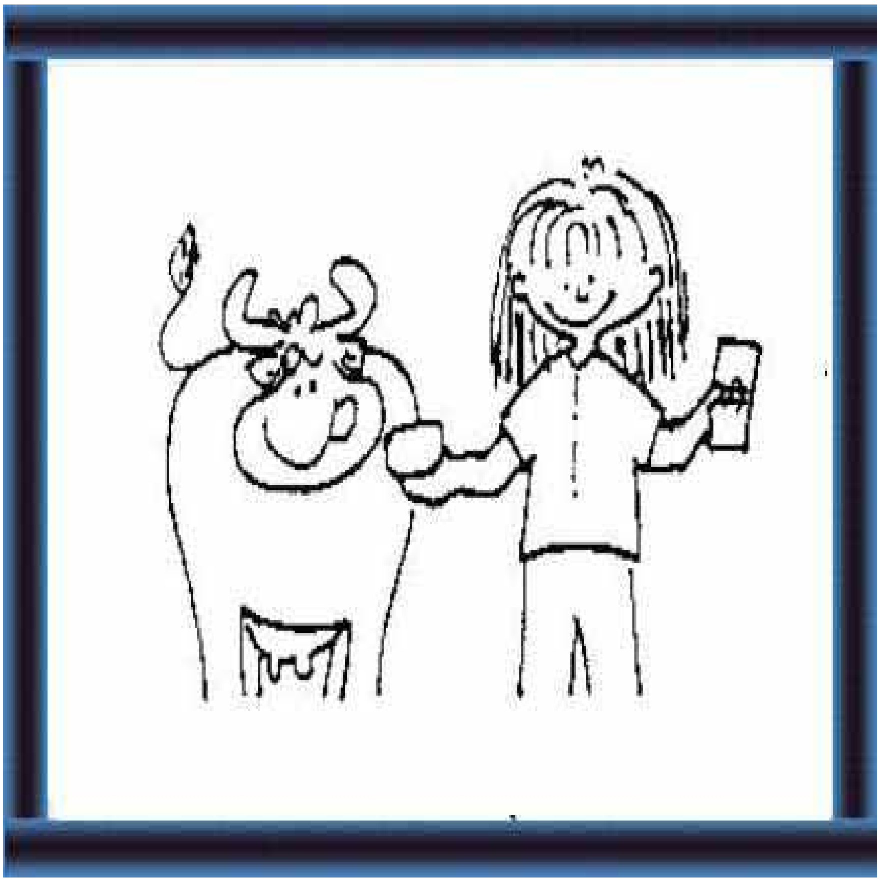
13 **Advantages** of **mineral blocks** (over powders) are:
- you can **make** the **blocks** **yourself** with materials from the market

14
- you can **choose**

the **composition** of the block for your feeds and your animals



15
- you can **leave** the blocks in the barn for your **animals to lick**
- even in the barn, there is **less wastage**.



16 Using mineral blocks:
- is **good** for your animals
- **saves you money**.

The procedure for making mineral blocks may be explained in several stages as follows:

Stage I: Composition of the mixture to be used for making the block

Some components in the mixture can be increased or decreased depending on the availability of minerals from the feeds consumed by the animals. Extension officers should give necessary advice on this aspect. (17)

An example of a mixture that would be suitable to make five blocks, each weighing 1 kg is given opposite. However, if the animals receive a feed containing adequate quantities of good quality rice bran, which is rich in phosphorous, the amount of dicalcium phosphate in the mixture can be reduced. (18)

How can you make mineral blocks?

Choosing a mixture

17 Consult your extension worker about the **correct mixture** for your feeds and your animals.

18 This example mixture can make 5 blocks of 1 kg each.

If your feed has enough rice bran, rich in phosphorus, you can reduce the dicalcium phosphate in the mixture.

Component	**Quantity in grams**
Cement	1000.0
Quicklime	125.0
Common Salt	1750.0
Dicalcium Phosphate	2000.0
Cobalt Chloride	1.0
Copper Sulphate	25.0
Potassium Iodide	3.0
Zinc Oxide	95.0
Sodium Selenate	1.0

Stage 2: The block

A wooden block can be made as shown to make blocks weighing about 1 kg each. (19)

Stage 3: Mixing the components

Cement, quicklime, dicalcium phosphate, common salt and zinc oxide.

Crush any crystals and large particles of these components and sieve to obtain a fine powder.

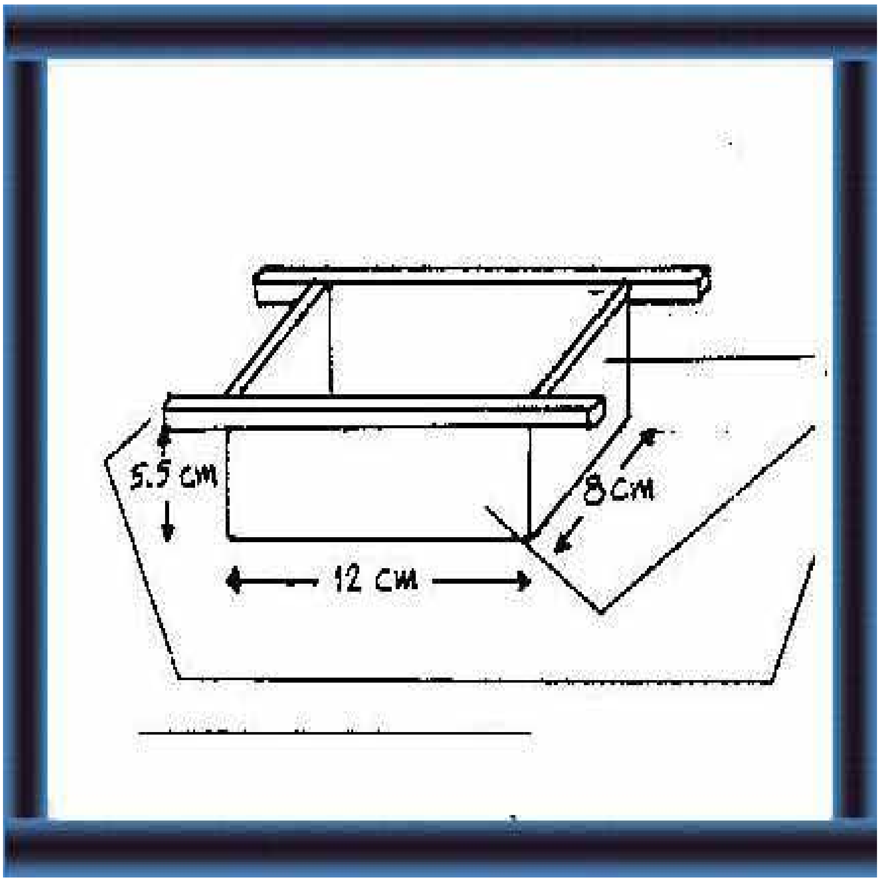
Mix them well in a bucket or other suitable container. (20)

Cobalt chloride, copper sulphate, potassium iodide and sodium selenate. (21)

Dissolve each component separately in about 100 ml (1/2 a cupful) of clean water.

Add the cobalt chloride solution to the mixture made above and mix thoroughly. (22)

Making the frame



19 Make a frame for 1 kg blocks using the following materials:
2 planks 1.5 x 5.5 x 8 cm
2 planks 1.5 x 5.5 x 12 cm
2 pieces of wood 2 x 2 x 25 cm

Preparing the mixture

20 Take the cement, quicklime, dicalcium phosphate, common salt and zinc oxide:
- crush crystals and large pieces
- put through a fine sieve
- mix together in a bucket.

21 Take the cobalt chloride, copper sulphate, potassium chloride and sodium selenate:
- dissolve each one in 100 ml ($^1/_2$ cup) of clean water.

22 Add each solution from 21 (begin with cobalt chloride) one-by-one to the mixture in 20. **Mix thoroughly** before adding the next solution.

Stage 4: Adding water

Add clean water to the mixture while mixing it thoroughly until it attains the consistency of a dough. (23)

Stage 5: Making the blocks

Spread a piece of polythene on level ground to cover the area of the block and place the wooden block on the polythene sheet. (24)

Add a sufficient quantity of the mixture to fill the block and compact it well. (25)

While adding the mixture, place two or three sticks (with a diameter of the size of a pencil) in position as shown to form two or three holes in the blocks. These holes will facilitate drying and can also be used to hang the block). (26-27)

Adding water

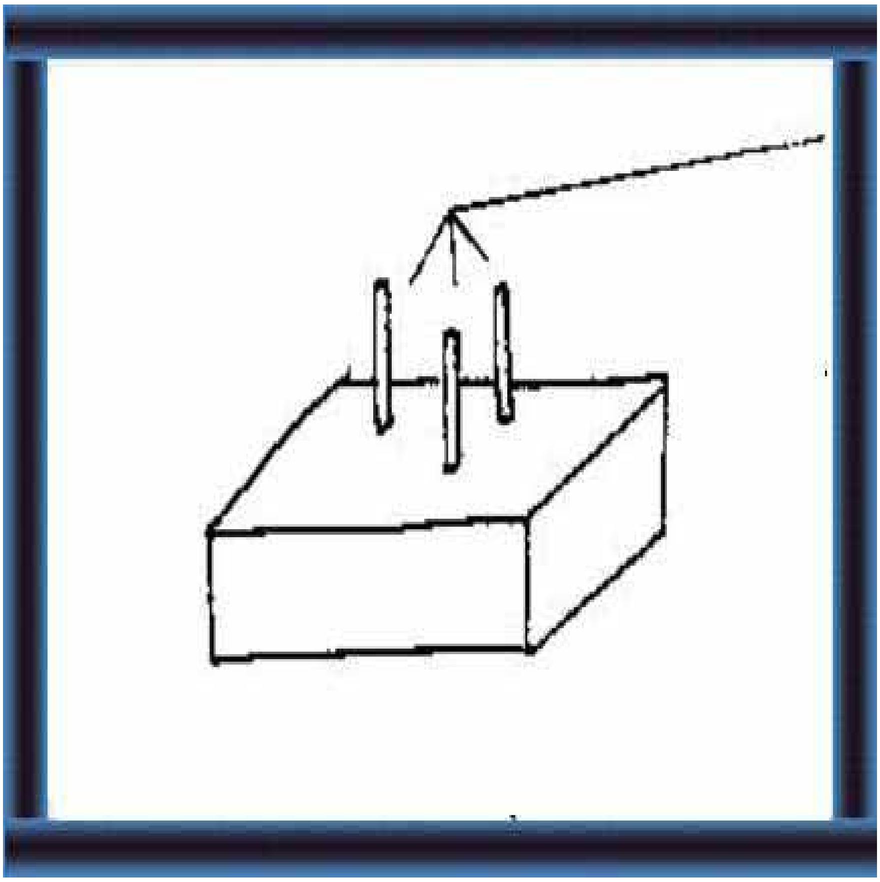
23 Add **clean water** to the mixture until it is like dough.

Making the blocks

24 Place a piece of **polythene** on level ground and put the wooden frame on top.

25 Add **enough** mixture to fill the frame.

Compact the mixture well.

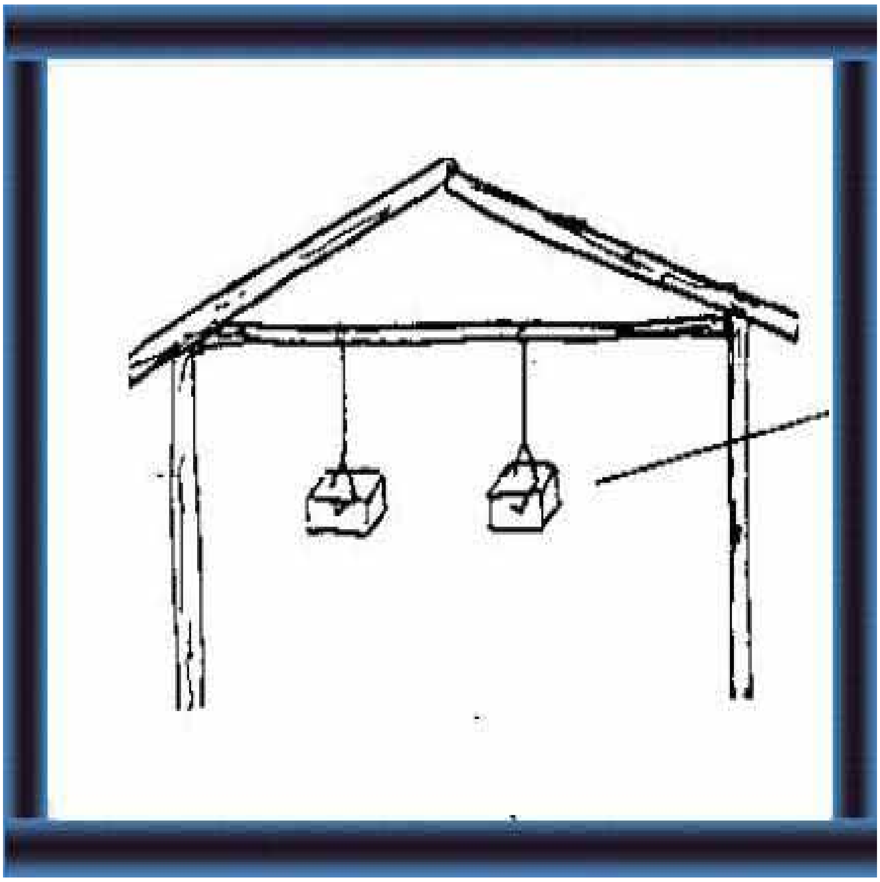


26 Add 2 or 3 sticks (the size of a pencil) to make holes in the block.

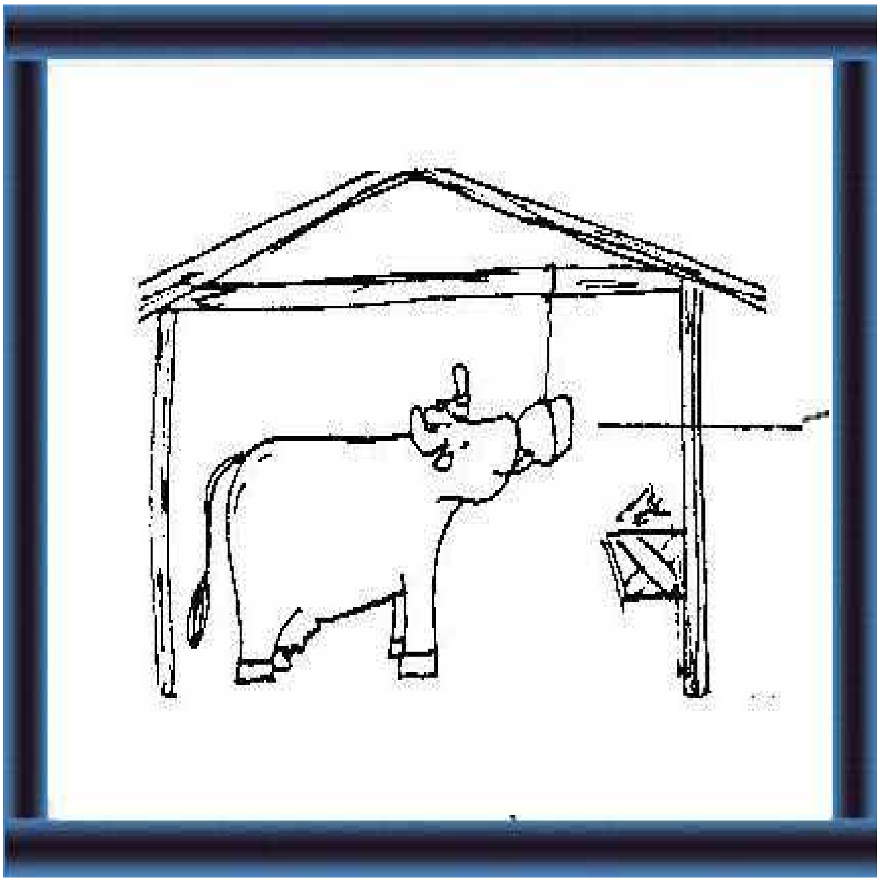
Stage 6: Storage

The blocks can be left in the barn (in a suitable place to prevent them getting wet) for animals to lick.

The blocks that are not required immediately and are to be kept for future use should be wrapped up in polythene and stored without exposure to air and water.



27 You need holes in the blocks to:
- help the blocks **dry**
- make it **easy** to **hang** the blocks.



How can you store mineral blocks?

28 When dry, hang a block
- where it does not get wet
- where your animals can lick it.

29. Wrap the other bricks up in polythene and store in a dry place for later use.

What do you know about minerals and mineral block making?