

APH 202

COURSE LECTURER: PROF. ALABA
JOLAOSHO

COURSE SYNOPSIS FOR PRM Dept.

➤ Elements of climate and their effects on forage and animal production including direct and indirect effects

➤ Differences between browse and non browse forages

➤ Introduction to forage conservation – hay, silage, crop residues, pellets feeds etc

❖ Lecture days – 02-05-2011; 9-05-2011: 10-12

❖ Practical days 04-05-2011; 11-05-2011: 8-11am

CLIMATE

Climate is made up of a composite of day to day weather conditions.

It is an average of weather overtime while weather is a state of the atmosphere with respect to heat or cold, wet or dry, calm or stormy, clear or cloudy.

It changes from day to day and variation is influenced by geographical location, topography, distribution of land and water, mountain barriers, altitude, wind, ocean currents and vegetation.

ELEMENTS OF CLIMATE

The major atmospheric elements making up climates in the tropics are moisture, temperature, light and air movement.

1. **Moisture:** Precipitation is the most important climatic element since temperature and light are less likely to be limiting for the growth of plants in the tropics.

a. Average rainfall and distribution: The total amount of rainfall fluctuates widely from one region or location to another. Average rainfall data are usually of limited value and distribution throughout the year is more meaningful for the agriculturist and the grassland husband man.

Grass and legume adaptation and production are largely determined by the amount and distribution of rainfall. Under all conditions, the distribution of rain determines the pattern of plant growth.

Rainfall intensity : In many parts of the tropics, a high proportion of the rainfall descends in heavy storms of short duration e.g. 50-100mm/h in 5-40mins and generally exceeds that of temperate.

Rainfall reliability: Total rainfall fluctuates widely at a given locality. Frequently, the beginning of the rainy season and the onset of the dry season are changeable and vary several weeks or even months.

The reliability of annual rainfall can be calculated however by knowing the average annual rainfall and the range over a given number of years.

Effectiveness of precipitation: Percentage of rainfall made available for plant utilization is influenced by the following variables.

1. Evapotranspiration
2. Surface run-off
3. Drainage of rainwater
4. Amount of stored water

Humidity: Moisture in the atmosphere is usually expressed as relative humidity i.e. the percentage of water vapour present given as a percentage of the amount which could be held at saturation. Relative humidity has a marked effect on the vegetation association in the different regions.

The coastal areas have a mean monthly relative humidity of 95% at 06.00 may drop to 60% at noon in the driest months. In the north, the moving relative humidity climbs up to 90% during the rainy season. In the dry season it seldom reaches 30% but drops to less than 10% before noon.

High humidity is associated with fungi problem that hinder seed production and livestock diseases.

Temperature: The tropics and subtropics have percentage that permits plant growth throughout the year except at higher elevations.

Seasonal differences occur with greater ranges in the wet-dry and arid climates than in the equatorial humid regions e.g. *Panicum maximum* and *Pennisetum purpureum* thrive well in the hot, lowland tropics but lower herbage yields in more northern latitudes and higher altitudes.

Chloris gayana, *Setaria anceps*, *Desmodium uncinatum* and *Desmodium intortum* Flourish at elevations where nights are cooler.

Lights: light is of basic important as the source of energy for the photosynthetic process. The intensity and quality of light varies with the angle of the sun's rays, duration of the light period and atmospheric conditions.

Air movement: movement of air are determined by differences in pressures which are linked with temperature phenomena. The air flow patters are also modified by friction produced by the earth's surfaces, especially mountain ranges.

Climate and Vegetation

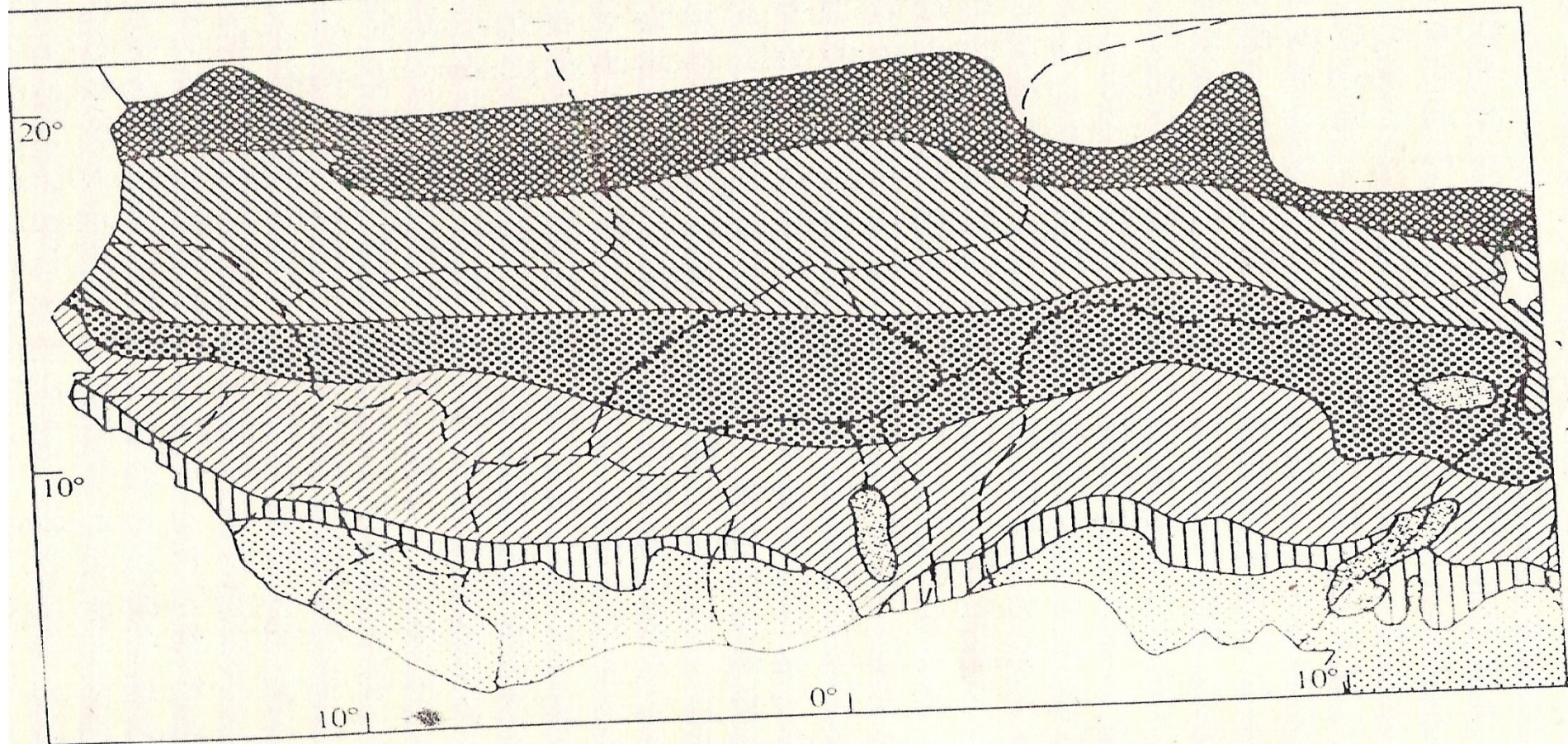
A close relationship exists between vegetation and climate as a consequence of plant evolvment and adaptation over ages of time.

A climax plant formation exist and is also called an association and consists of several spp.

Rainfall distribution (mm/year) in West African(Thompson,1965) in West Africa, four of the main vegetational zones are commonly called savannas and are recognized as climatic regions representing different agricultural interest.

Their boundaries are in part related to those delineated by the type of genera of the grass distribution, namely:

1. *Pennisetum* type- lowland forest and derived savanna
2. *Hyparrhenia* type- Southern Guinea savanna
3. *Andropogon* type- Sahel and part of Sudan savanna
4. *Aristidia* type- Sub-Saharan










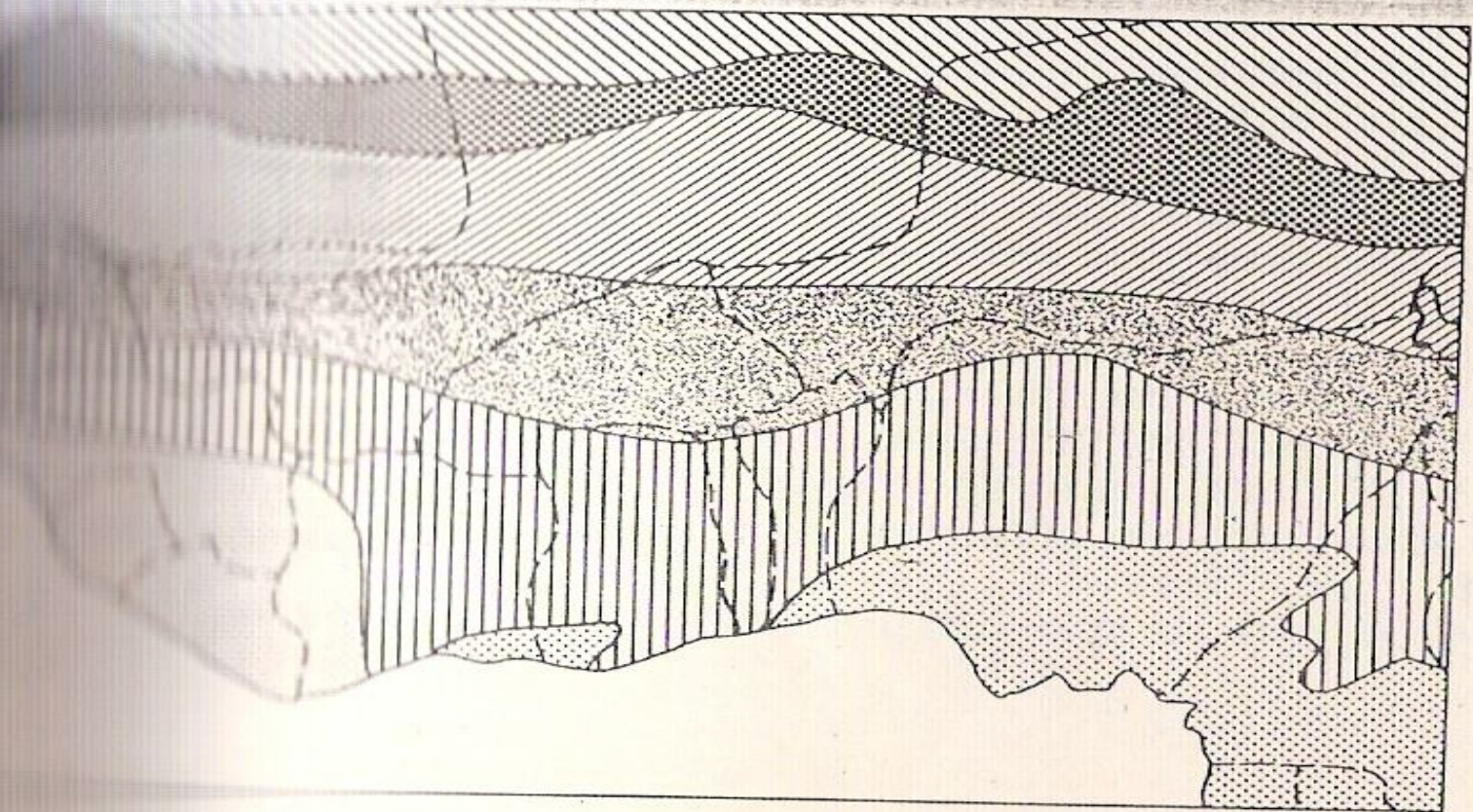



- | | |
|--|--|
|  Moist forest, mangroves and swamps |  Woodland dry savanna (Sudan) |
|  Derived forest-savanna |  Wooded steppe (Sahel) |
|  Montane forest |  Subdesert steppe |
|  Woodland humid savanna (Guinea) | |

Fig. 1.2 - Vegetational zones of West Africa (Keay, 1959): (1)

... (Fig. 1.2) and the rainfall map (Fig. 1.3) o

Precipitation



-  200-400
-  100-200
-  Below 100

Precipitation distribution (mm/year) in West Africa (Thompson, 1965).

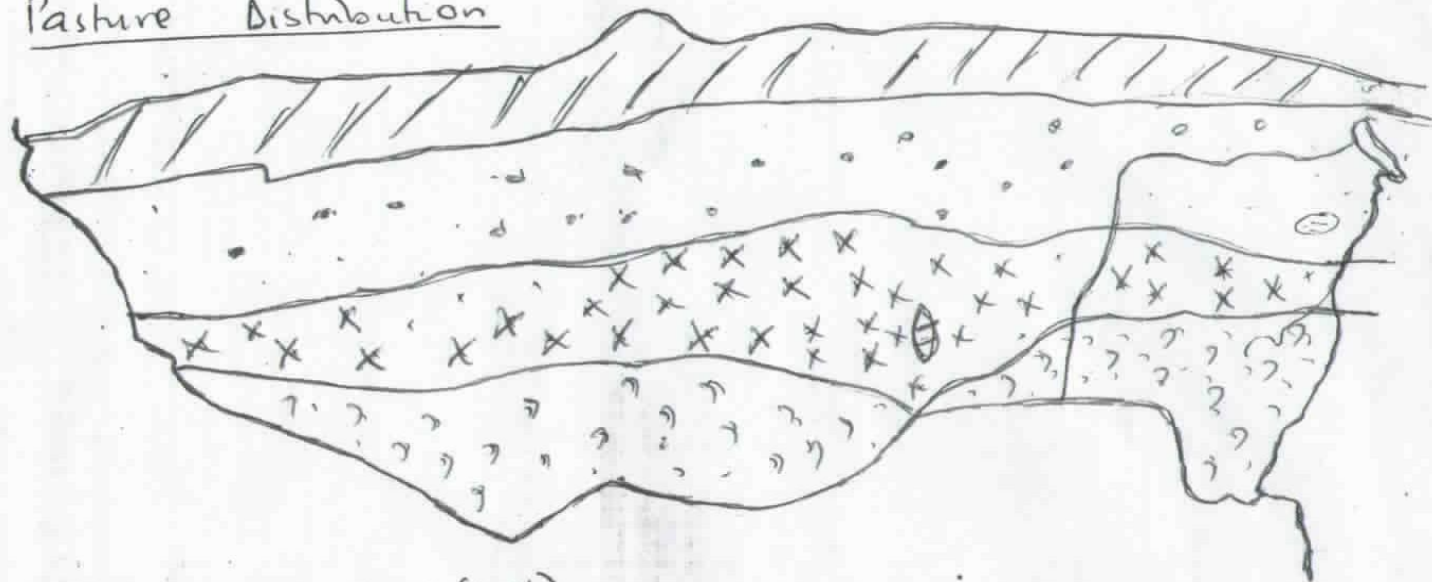
Mm/yr

1600 or more

800-1600

400-800

Pasture Distribution



- Pennisetum type (belt)
- Hyparrhenia type
- Andropogon type
- Amisclia type

Tropical rainforest and swamps: Two peaks of rainfall alternate with two dry seasons. A longer drought period prevails from October or November to March or April and a shorter one occurs in July or August, dry season ranges from 3-5 months.

The forests are broken vertically with 2 or 3 layers of trees, the tallest storey emerging at more than 30m. Tall coarse grasses appear in the more open lands of the forests.

Guinea savanna ('humid savanna'): The derived savanna merges into two woodland savannas' which are separated on the basis of moisture and vegetational core. It is characterized by 5-7 months of dry season, usually continuous.

Rainfall varies from about 1,000 to just less than 1,500mm the area is largely woodland with fire-resistant, broadleaved deciduous trees. The canopy may be full or open at 15-20m. Tall perennial tufted grasses grow up to 3m beneath the scattered trees and up to 5m open places.

Since, the cattle population is relatively sparse, a heavy growth of grass accumulates by the end of the rainy season. Always widespread fires rage beyond control.

Sudan Savanna ('dry woodland savanna') receives from 500-800mm annual rainfall with 7-9 months having 100mm total.

The region is wooded but many single trees occur and display wide, spreading crowns and small leaves. The trees grow from 10-15m height and shorter than in the humid savanna, there are many leaves growing shrubs and bushes in the southern areas.

Thorn bushes are prevalent in the northern part of the dry savanna. Grass cover is shorter than in the humid savanna, from 1.5m to just over 3.0m in height when matured, less tufted, more feathering with finer leaves and stems, and fewer perennials.

Much of the area is burned annually, but fire is less severe than in the derived savanna.

Sahel savanna ('wooded steppe'): water deficit exists for most of the year and many areas receive less than 200mm of rainfall. The rain occurs in down pours scattered over a 2-3 month period.

The original climax was probably thorn woodland which opened up with scattered dwarfed trees of 5-10m height. Thorn shrubs of 2-3m height with short conical bases and divided stems are common.

Grasses are short, discontinuous, wiry and tufted. Less serious fires than further south.

Sub-desert steppe: It is a fringe in the southern Sahara. In some places dispersed, permanent vegetation prevails, being composed of small shrubby plants and bushes, with acacias, other trees and shrubs.

This area receives about 150mm/year and are extremely unreliable.

After rains, annual grasses and herbs appear and soon mature. Altitude modifies the vegetation due to increased humidity and cloudiness, lower temperature and less evaporation.

Differences between browse and non browse forages

Browse: A class of range forage including twigs with their shoots and leaves which are selectively cropped by livestock or other wild herbivores from shrubs, small trees and woody vines.

Herbage for livestock from trees and shrubs is known as browse.

It may be eaten directly from the natural growth of plants or from regrowth of sprouts after cutting near ground level (known as coppice).

In addition, woody plants can be cut or lopped from taller shrubs and trees, where the twigs, seeds, pods and even the bark are eaten (known as pollarding).

Browse plants are available at the peak of the dry season when non browse becomes fibrous and dry up with low crude protein content of less than 3%. Browse plants have tap root system that can be as deep as 6m into the ground. They are less subjected to seasonal variation than grasses in terms of nutrient content.

Browse plants alone keep healthy animals in fair condition, but may be inadequate as sole feedstuff. Much of the material is high in protein, ranging from about 10 to more than 25 % on dry weight basis, and is high in most minerals except P may be below 0.12%. Crude fibre content ranges from 30 to 60% compared to 60 to 80% for the dry patched grasses.

Browse plants are more digestible than grasses during the dry season and equal or greater than *Centrosema pubescens* and other herbaceous legumes, with intake of 9.0-12.2% overall and 1.8 – 2.3% of liveweight. Cattle grazing dry and mature grass and supplemented with edible pods maintains their weights.

Cattle do not browse indiscriminately but concentrate on particular species, if given a choice depending on: 1. availability of grasses and browse plants; 2. length of grazing time; 3. time spent in walking; 4. adjustment to browse plants.

Non Browse forages: are grasses and other herbaceous plants. These are mostly non-woody and are susceptible to climatic variations.

Examples of browse plants



***Albizia lebbbeck* (L.) Benth.**

Common names

Indian siris, acacia tree (Australia); mataratón (Colon, Panama); tibit tree, acacia (El Salvador).



**Family: Leguminosaeae
(Mimosaceae)**

***Leucaena leucocephala* (Lam.) de Wit**

Common names

Leucaena, koa haole (Hawaii), ipil-ipil (Philippines),
Acacia bella rosa, Aroma Blanco, Jumbie bean, Vaivai

Gliricidia sepium (Jacq.)

Common names

Gliricidia, mata raton (Spanish)



Examples of non-browse plants: Herbaceous Legumes

Tephrosia

Tephrosia bracteolata Guill. & Perrott.

Tephrosia linearis (Willd.) Pers

Tephrosia lupinifolia DC.

Tephrosia obcordata (Lam. ex Poir.) Bak.

Tephrosia platycarpa Guill. & Perrott.

Tephrosia purpurea (L.) Pers.



Guinea grass (*Panicum maximum*)



elephant grass (*Pennisetum purpureum*)

Introduction to forage conservation

Herbage availability during the wet season often exceeds animal requirements which could be conserved for supplementary dry season feeding. The accumulated forages loses most of its nutritive value with maturity.

The aim of forage conservation is to produce at low cost, a stable product suitable for animal feeding with minimum loss of nutritive value.

Deterioration due to internal chemical changes and external microbial action of cut herbage are prevented either by dehydration (hay) or acidification (silage).

TYPES OF FORAGE CONSERVATION METHODS

BUSH FOGGAGE: conservation is in situ by leaving excess herbage and browse plants as standing vegetation in the grazing area.

Animals grazing bush foggage maintain bodyweight if provided with salt-mineral block licks and supplemented with small quantities of protein feeds.

STANDING HAY: Townsville stylo (*Stylosanthes humilis*) 'hays off' after seeding and remains hay with 12% protein until the first rains of the following dry season.

Hay: A high quality hay can be defined as a forage dried so as to retain most of the leaves, without deterioration of dry matter and nutrients, without mould development, having its natural green colour and palatability, and capable of being stored over a long period of time.

The early flowering stage appears to be the most appropriate time to harvest grasses for hay.

Unreliable weather conditions and generally poor herbage quality are the two most serious constraints to large scale hay production in the tropics.

Uneven land surface, lack of technical know-how and lack of hay-making equipment are also important inhibiting factors.

Average losses of dry matter during hay-making and storage can be up to around 25-30% and may be greater.

From the time of forage cut to the time it is adequately dried for storage, dry matter losses and deterioration in nutritive value and quality occur due to respiration and fermentation, mechanical and handling damage and weather effects

For production of superior quality hay, conditions must be favourable for rapid removal of moisture from cut herbage. This is achieved by

(1) making hay during periods most likely to have continuous sunshine

2. Drying the herbage partly in the field and partly under artificial conditions

3. Complete artificial drying

4. Pre-harvest desiccation of forage with chemicals such as formic acid and

5. Crushing, bruising or cracking forage stems by mechanical devices to accelerate drying process

Hay making procedure

1. Cut the forage.
2. Allow to dry on wind-row in the field and stack when dry
3. To minimize losses due to rain and to facilitate drying, the forage can be stacked on tripods, hurdles and racks in the field
4. Kilns and smokehouses have been occasionally used to complete the drying

Silage

This is a moist succulent feed produced as a result of controlled fermentation of fresh forage stored in a silo under anaerobic conditions.

Tall –growing fodder grasses such as *Panicum maximum*, *Pennisetum purpureum*, *Setaria anceps* and *Tripsacm laxum*, when well managed and fertilized are suitable for silage making.

Likewise, crops such as maize, sorghum and millet with or without legumes are also used.

The prostrate, stoloniferous grasses and trailing legumes are less desirable.

The quality of silage depends on the stage of maturity, dry matter and nutritive content, particularly the carbohydrate fraction.

Silage making procedure

To produce good quality silage, most grasses should be harvested in the vegetative stage of growth and not later than early bloom stage, cereal crops can be cut and ensiled at pre-bloom or boot stage to early dough stage, but preferably at the early milk stage.

SILOS

The containers used for silage-making range from the sophisticated and expensive gravity self-feeding vertical silos to the simple and inexpensive do-it-yourself trench or pit silos.

Production of silage

Consolidation of the cut and usually chopped herbage can be effected by tractors or heavy rollers in the larger open-ended silos or manually in the smaller silos.

Plant respiration continues after the silo is filled and until the oxygen present in the air and trapped in the forage is used up.

Respiration leads to break down of carbohydrates to carbon dioxide, water and heat.

Proper compaction restricts carbohydrate losses due to respiration.

The fermentation process is initiated by enzymatic activity and presence of yeasts, moulds and aerobic bacteria.

This results in breakdown of structural carbohydrates and sugars and the production of various acids such as acetic, propionic and lactic. Degradation of protein into simpler substances such as amino acids and ammonia also occurs.

As oxygen is exhausted and acidity increases, moulds and yeasts cease to grow or disappear and only the anaerobic bacteria remain active.

TYPES OF ACIDS

The type of acid produced depends on the organisms present.

Clostridia are mainly responsible for the production of butyric acid. This group should be prevented while lactic acid bacteria should be encouraged because conversion of sugar to lactic acid involves small energy loss and it is desirable for milk production.

Increasing acidity and high osmotic pressure controls the activity of anaerobic bacteria and their growth is completely inhibited when the pH value falls below 4.2.

Further, anaerobic decomposition during storage is prevented and the silage remains in a stable condition for a considerable period of time if kept properly sealed and covered to prevent entry of air and water.

A well-preserved, unwilted silage has a pH of 4.2 or below, butyric acid concentration of less than 0.2%, ammoniacal nitrogen content of less than 11 % of total N and lactic acid concentration of 3-13% of dry matter and exceeding that of volatile acids.

The efficiency of silage – making can be significantly improved by judicious use of harvesting, storage and handling equipment, proper compaction and careful and careful sealing of silos, mechanical treatments such as fine chopping and laceration of herbage before ensiling, wilting and use of additives.

Losses in silage-making

Losses in Dry matter and nutritive value of silage ranges from 10-20% or higher due to

1. Field spoilage
2. Type of fermentation
3. Seepage or effluent
4. Spoilage or wastage during storage and after the silo is opened for feeding due to entry of air

Silage additives

Additives either inhibit anaerobic decomposition by significantly reducing the growth of bacteria or stimulate the natural fermentation processes during silage-making.

A number of nutritive additives have been used, such as molasses, cereal grains and citrus pulp, as well as non-nutritive additives such as sodium metabisulphate, calcium formate, formic and other mineral acids and antibiotics, inoculation with lactic acid bacteria.

The choice of additive will depend on availability, cost facilities required for mixing and handling, and the farmer's knowledge of silage-making.

Biological Residues: crop residues

After a crop is harvested the plant materials left in the field constitute the crop residue comprising of spilled or unthreshed grains, voluntary weeds, grasses and other forage materials growing in fields and along boundaries, irrigation channels and roadsides.

The nutritive value and quantity varies and depend on the species and variety of crop, farming methods and environmental conditions prevailing in the area.

Among the various crop residues available for animal feeding are rice straws, cowpea husks, melon husks, cassava peels etc. Crop residues generally provides maintenance ration and minimizes weight loss.

The highly lignified cereal straws and stovers are poor in nutritive value and their usefulness as supplement is mainly limited to providing additional bulk to ruminant diet, so necessary to provide additional protein or non-protein N, energy supplementation and minerals, particularly sulphur and phosphorus.

Urea and molasses can be profitably used in many tropical countries as the major components of supplementary ration.

Undersowing crops with forage legumes offers another possibility for efficient utilization of crop residues with low protein and high fibre.

The crop yields can be maintain at, or near, normal levels by manipulating crop and legume density, crop maturity type, sowing dates of the crop and legume and fertilizer applications.

Other ways of improving digestibility or improving feeding quality of poor quality crop residues as well as hay are using molasses, cassava, alkali treated roughages, treatment with hydroxides such as sodium hydroxide

Animal Residues

Recycling of animal waste, particularly poultry litter, as a source of nitrogen in ruminant diet has been found potentially worth.

Broiler litter is waste product of poultry houses and contains bedding materials, excreta, waste feed and feathers. The litter is high in nitrogen and ash content.

The usefulness of animal waste as a supplementary feed will be limited until the danger of potential hazards to human and animal health from the likely presence of various drug residues and pathogenic organisms can be overcome.

Pasteurization by heating the litter or addition of antibiotics will help in controlling harmful micro-organisms.

Industrial by-products

Cereal brans, oil cakes, cottonseeds, molasses, citrus pulp and brewery by-products are few of the numerous by-products for livestock feeding.

These products are capable of providing energy, protein, minerals and vitamins and they can be reprocessed , enriched and sold as concentrate feeds.

But, bulky product like pineapple waste bran from canning industry, though, it is a good source of energy is of high moisture content and uneconomical for long distance transport

Waste paper except newspaper is more digestible than the roughage used for its manufacture. In the process of paper making, the material had been highly delignified.

Chemical and concentrate supplementation

Growth and productivity of animals maintained entirely on the available herbage from grazing lands and crop residues are erratic, and the characteristic 'stop-go' cycle of growth can be favourably modified to a considerable extent by judicious supplementary feeding of concentrate and minerals.

Concentrates are rich sources of energy and/or nitrogen for the animal and contain little or no fibre and varying amounts of minerals and vitamins.

They can be classified as carbohydrate concentrates, vegetable and animal protein concentrates and mixed concentrates.

ECONOMIC CONSTRAINTS

1. Low genetic potential of Tropical livestock.
2. High prices of grain or its greater value as human food
3. Scarcity of oil cakes and oils seeds and their large-scale export overseas at high prices
4. Unattractive market prices
5. Lack of consumer appreciation for better-quality livestock products due to generally low standards of living.

6. Lack of accurate information on the feed requirements of various classes of tropical livestock for maintenance and production
7. Nutritional values of a wide variety of locally available feeds

Pellets: The grinding or milling of dried herbage causes breakdown of material into fine particles.

Processing of this material into pellets significantly alters nutritive value by increasing the voluntary intake and efficiency of utilization digested nutrients, even though percentage digestibility is decreased.



THANK YOU

