

# **UNIVERSITY OF AGRICULTURE, ABEOKUTA**

## **DEPARTMENT OF PASTURE AND RANGE MANAGEMENT**

### **LECTURE NOTE**

**COURSE TITLE:       TECHNIQUES IN PASTURE MANAGEMENT (2 UNITS)**

**COURSE CODE:       PRM 503**

#### **OBJECTIVE:**

After going through the course, students are expected to fully understand strategies for establishment, management and effective utilization of pastures for sustainable production of good quality forage for improved ruminant animal production.

#### **COURSE OUTLINE**

Review of some common terms in pasture/forage science (forage, fodder, feed etc)

Pasture types, their attributes and characteristics, their importance and roles in animal production in Nigeria, sole/single species pasture grass/legume pasture, role of legumes, factor affecting legume content.

Pasture establishment: factor to consider in the selection, land preparation (slashing, clearing, ploughing and harrowing, planting/sowing), sourcing of planting materials, methods of planting/sowing for different species and pasture types.

Post-planting/sowing management: fertilizer application/manuring, fertilizer types and effects on dry matter yield and botanical composition, weed control, re-sowing/planting cutting back, pasture consolidation.

Grazing management: Definition and objective, when to graze a newly established pasture and proper grazing methods (continuous grazing, rotational grazing, leader-follower, strip grazing, zero-grazing season, ungrazed, deferred grazing, rest period, grazing pressure, carrying capacity, animal days, animal unit), grazing effects on growth and productivity.

Pasture utilization: Definition and estimation on grazed pasture, factors affecting utilization.

Pasture defoliation and defoliation techniques, components of defoliation (frequency, intensity and timing) and effects on productivity, botanical composition, methods of estimation and important.

Pests and diseases; their effects on dry matter productivity, pasture quality, seed and yield and quality, evaluation and control.

### **Review of terms**

**Forage:** Vegetative plant parts (i.e leaves, flowers and stems of plants) eaten by animals, could be domesticated or wild animals.

**Fodder:** More specific term referring to the vegetative part of cultivated forages or crops used as forages

**Feed:** Is a more general term that includes also non-vegetative plant parts e.g grains, seed etc. fed to animals. Sometimes, it is difficult to differentiate between

feed, forage and fodder, for example when animals consume the seed head other part of herbaceous plants together.

Forages and fodder are mainly sources of nutrition for ruminant animals because these animals are capable of producing useful outputs from these natural resources that humans can not consume directly. The products produce by the animals provide essential nutrients for human existence. So, management of forage resources for production of ruminant animals is largely complementary to cultivation of food crops.

Forages crops are classified into two basic broad groups.

- (i) Herbaceous plants
- (ii) Woody plants.

While woody plants grow cumulative over many years, herbaceous species show an annual cycle of growth and decay, regrowing each year from seed, but perennial herbaceous species regrow from existing root stock.

Among the herbaceous group, two subgroups are of particular interest as sources of forage, namely:

Grasses: These make up the bulk of plants found in many mixtures of the natural vegetation that supply animal feed. Grasses also have certain characteristics that make them very suitable as herbage plants.

Assignment: *What are the characteristics that made grasses suitable as herbage plants? State the importance of each of those characteristics.*

Legumes: these have a relatively high value for animal production, mainly on account of the high nitrogen content in the vegetative matter that represent the

animal feed. They also play significant roles components in sustainable agricultural systems.

### Types of grazed pasture

Grazed pasture may be classified into:

1. Natural or Semi-natural Grasslands
2. Improved permanent Grasslands
3. Artificial grasslands or Leys (Temporary pastures)
4. Irrigated pastures

### **Natural of Semi-natural pastures**

The herbage species are not sown or planted and the component species have evolved from competition with other species in harmony with the prevailing soil and climatic factors.

In the climax stage, the floral composition has relatively been undisturbed by any human agency or interference apart from, probably, control of grazing animals, generally by herding, and more or less frequent annual burning.

The natural grassland are climax or sub-climax types that have evolved in harmony with the soil, climate and environmental factors, including firing and under a systems of lenient grazing or frequent heavy grazing by migratory heads of livestock.

The major species found in this pasture are unimproved native or naturalize grassed much less of legumes and other broad leaves which account for the poor nutritive quality f the pastures for most of the year.

Most tropical grazing lands are in this category. The tropical natural grasslands if improved and adequately exploited are expected to form major centers of livestock production of the world.

Davies (1960) noted that these grasslands carry nearly half of the grazing livestock and produces one-third of the meat and one-sixth of the dairy products of the world.

The carrying capacities (cc) vary depending on the location of the natural pasture.

The cc and average of herbage production of natural pastures in Nigeria as estimated by Olayiwole and Olorunju (1987) are as shown in the table below:

Savanna Area	Carrying Capacity	Average/Herbage production
Derived Savanna	0.4-83 ha AU <sup>-1</sup>	6.0-18 t ha <sup>-1</sup>
Southern Guinea savanna	1.0-4.0 ha AU <sup>-1</sup>	2.0-6.5 t ha <sup>-1</sup>
Northern Guinea Savanna	3.0-5.0 ha AU <sup>-1</sup>	2.0-4.5 t ha <sup>-1</sup>
Sudan Savanna	8.0-12.0 ha AU <sup>-1</sup>	0.7-2.5 t ha <sup>-1</sup>
Sahel Savanna	10.0-14.0 ha AU <sup>-1</sup>	0.5-1.5 t ha <sup>-1</sup>

1 animal Unit (AU) = 300kg live weight requiring a daily dry matter intake of 7.5 kg at 2.5 kg/100kg live weight.

## **Improved permanent grasslands**

The constituent herbage species in this pasture type have not been planted or sown, but the botanical composition has been modified in favour of the more productive species by careful control of grazing or by mowing, drainage, application of fertilizers or manures, surface cultivation, re-seeding and weed control.

Other factors that influence the botanical composition of the sward are rainfall, altitude, exposure of site and type of grazing stock. In regions where pastures are intensively grazed such as in America, Australia and UK) improved permanent pastures are graded according to the proportion in the sward of the highly rated species, for instance in the United Kingdom, three species are used as standard, namely rye grass (*Lolium perenne*), bent grass (*Agrostis* spp) and wild white clover (*Trifolium* spp).

1<sup>st</sup> grade pasture: rye grass/clover

2<sup>nd</sup> grade pasture: rye grass/*Agrostis*/clover

3<sup>rd</sup> grade pasture: *Agrostis*/rye grass/clover

4<sup>th</sup> grade pasture: *Agrostis*/clover

5<sup>th</sup> grade pasture: *Agrostis* alone

The best quality fattening pastures in the UK belong to the 1<sup>st</sup> grade while the *Agrostis* alone pastures is found in poor infertile soils whose grass cover has been mismanaged by overgrazing in the dry season or under-grazing in the wet season.

Even though tropical pasture husbandry has not developed to this stage, several productive grass/legume associations have evolved in different parts of the tropics,

e.g giant star grass/centro, panicum/centro, panicum/stylo, cynodon/stylo, cynodon/centro, molasses grass/tropical kudzu etc.

### **Artificial grasslands or leys (Temporary pasture)**

The herbage plants are fully sown or planted with deployment of all procedures for land preparation, planting and agronomic management. All sown or planted pastures (sole grass, grass/legume or sole legume) belong to this group.

The pasture could be for long duration or short duration use depending on the duration of the rotation in which it features.

Long duration leys with life span of three to four years or less are frequently included in crop rotation for the purpose of restoring soil fertility especially when animal grazing is introduced but legumes or grass/legume mixtures are generally preferred for soil fertility restoration.

The leys could be cleared after 3-4 years and alternated with 3-4 years of cropping with considerable soil improvement.

### **Irrigated pastures**

There may be natural pastures that are naturally irrigated as found along the white Nile and its tributaries in the Sudan and along Zambezi and its tributaries in Rhodesia. These provide dry season grazing resource to migratory herds.

Artificially irrigated pastures are not common in the tropics mainly because of the financial implication of establishment and provision of irrigation facilities.

Irrigated pastures are mostly used for intensive grazing rather than for soilage, or feeding of cut herbage. Some of the problems of irrigated pastures include bloat, land compaction and pudding. Also, in order to maintain high

production heavy input of fertilizers is necessary which may also lead to problems of nitrate poisoning.

### **Cultivates or sown pastures**

These are improved grazing lands comprising introduced or planted grasses and/or legumes for temporary or permanent grazing. They may be established by:

- i. Improvement of native or naturalized grasslands by some form of sod disturbance, fertilization and introduction of new species by sowing or transplanting
- ii. Renovation of a previously developed pasture
- iii. Development of a previously cultivated land
- iv. Development of virgin/forested land into pasture

A sown pasture could be one of sole grass or grass alone, grass/legume or, most uncommonly, sole legume or legume alone.

Assignment: *Read more about characteristics of sole grass, legume and sole legume pastures.*

### **Requirements of cultivated pastures**

Reasonably good soil: because pastures are relatively shallow rooted compared to most field crops which are planted every year. Deep soils are not very essential, but good chemical and physical properties are necessary.

Rainfall – Areas with over 750mm per annum rainfall (without supplementary irrigation) are suitable.

Slope: Pastures can be mechanically cultivated in slopes up to 15%.

-8- 15% with deep soils are likely to go to annual field crop.

## **SITE SELECTION**

Selection of site is the first step in pasture establishment and the following must be considered. Intensity of leaching – leached soil indicate good drainage, (acidity can be corrected by liming).

Soil depth-very shallow soils are unsuitable as they are very highly erodible.

Soil texture – Loamy soils have good water/fertility characteristics and are suitable for major pasture species.

## **SUITE PREPARATION**

- Top soil/water conservation is a top priority to prevent soil erosion and washing away of planted seeds during the vulnerable establishment period.
- Conservation structures that could be first place include.
- Contour walls to remove excessive run-offs
- Terracing to reduce run-off and increase infiltration rate
- Contour strings of soil forming grasses to infiltration rate and cash site

The objective of seed-bed preparation is to produce a weed-free, fine, firm moist leveled and well drained seed-bed. Seed beds need to be fine and firm to ensure that small grasses and legume seeds make good contact with most soil particles. Without this content, pasture establishment may be patchy and weed seeds will establish and compete with pasture plants infiltration rate and cash site.

Seedbed preparation: is most important with pastures as seeds are usually small in size requiring smoother, finer, moist seedbed. A seedbed should have the following characteristics.

- a. Ample moisture in the surface and subsoil.

- b. The surface soil should be reasonably smooth to prevent the seed being buried too deeply.
- c. The surface soil should be moderately compacted around the seed to facilitate the transfer of moisture from soil to seed.
- d. The surface soil should be granular and too fine or pulverized for this would prevent the entrance of air and water into the soil.
- e. The soil should be firm beneath the depth at which the seeds are sown to give firm support to the developing seedling and to allow close contact between seedling roots and the soil for nutrient and moisture absorption for the plough layer should be in direct contact with the lower soil layers to provide for uninterrupted upward movement of soil moisture.
- f. The surface soil should be worked well enough to provide good operating conditions for seedling and the machinery and
- g. The top soil should be as free of weeds and insect pest as possible.

### Sowing/Planting

The type of pasture in question or the type of planting material used will determine the method of planting to be adopted. Types of cultivated or sown pastures may include:

- Pure grass
- Grass/legume
- Pure legume (mostly used for supplementary grazing in the dry season)

For sole grass pasture, most grasses in the tropics (Nigeria) uses vegetative cuttings, crowns, and less often seeds. Where vegetative material is used, this has to be sourced, prepared by removing the foliage to reduce evapo-transpiration and moved to site. Usually this involves movement of massive material which may add

to cost of establishment in transport cost and may be destructive. Few tillers or spilt crown (e.g Panicum spp), stolons (e.g cynodon), mature stem cutting with two or more nodes (e.g pennisetum spp) may be planted per stand. In stemy species like Pennisetum the whole stem may be buried and this sprout s at the nodes.

## **FORAGE UTILIZATION**

Forage utilization has been variously defined as follows:

1. The degree to which animals have removed the current growth of herbage, expressed in percentage of growth within the reach of the grazing animals.
2. Since utilization refers to the percentage of current growth removed, a more appreciate term to describe it might be percentage utilization.
3. Pasture utilization could be conceived as the efficiency with the dry matter produced I converted to animal products. This definition recognizes the necessity for establishing the true value of a pasture once that value is transformed into animal products as an indirect measurement of forage utilization.

Pasture Management: This could be discussed under:-

- Fertilizer management/manuring
- Grazing management/cutting management

Pasture Management is all agronomic input and activities that are necessary for the production of an adequate quantity of good quality forage feed for sustained production of the desired animal products (such a meat, milk, hides and skin wool etc.) in satisfactory quantity and quality. Such adequate weed control, proper stocking or proper grazing, appropriate fertilizer use or application, introduction of appropriate forage species renovation of existing pasture land etc.

## **Fertilizer management**

Poor nutritional status of grasses frequently restricts animal carrying capacity, but higher productivity of tropical grasses can be expected with proper exploitation and management. In general output of grasslands and grazing lands can be increased by application of fertilizers. The magnitude increase in yield will however be influenced mainly by climatic and edaphic factors and their interaction with the species compositions of the grazing land. There may be occasions when appreciable and expected response to fertility application may not occur due to loss of nutrients by volatilization, leaching, fixation by the soil, transformation into others compounds and depletion of essential elements. Often times, sizable amounts of nutrients are needed for maximum dry matter yield the most soils can supply especially under intensive management systems. The nutrient status of the soil should be assessed by taking soil samples and making chemical analysis. This information often supplemented with pot culture, using test plats that are sensitive to nutrient deficiencies. In addition, field experiment plant analysis and the appearance of the foliage provide clues to the nutrient statuses of the soil. Grasses and legumes differ in their nutrient requirement and the definition of these needs is important in seedling establishment, plant growth and maintenance of a desirable botanical composition.

### **Factors to be considered in the use of grazing lands include:**

#### **1. Economic returns**

Under conditions of intensive beef and dairy production system, some supplemental plant nutrients are required for optimal output which may necessitate the use of external resources (i.e fertilizer) to boost herbage

yield. But with less intensive livestock management it may be more economical to increase the area of grazing land as is usual practice now in most of the tropics. Other points to consider here include the type and quality of cattle, price of animal product, cost of fertilizer and return on investment the level of technology and the managerial skill of the farmer.

2. Species present and botanical composition many native or naturalized species do not respond to fertilizers in terms of increased herbage production. The quality of the herbage produced in terms of CP, or mineral content species differ their fertility, requirements some grasses e.g *Melinis minutiflora* (molasses) grass, *Cynodon dactylon* (Bermuda grass) and *Stylosanthes humilis* (Townsville stylo) are to persist under conditions of low fertility. Grasses generally respond to the application of N and legumes to P. If legumes are to be maintained insignificant proportion, it is important to apply phosphate fertilizer at regular interval.

### **3. Nutrients in the soil and other availability**

The quality of nutrients available in the soil for plant use varies with soil type, available moisture, temperature, microbiological activity and previous use of the land. Some nutrients are readily available in the soil solution other are released by mineralization while some fixed within the soil and may or may not be released over time.

### **4. Quantity of nutrient removed**

The extraction of nutrients from the soil is roughly proportional to the yield of herbage is also a function of chemical composition of the herbage. Thus, a grass yielding 20 t/ha per annum of DM and containing 1.5% N would remove 300kg of nitrogen. The chemical constituents in the herbage may become lost completely under the system of zero grazing. Under grazing pastures may require much fertilizer input as the grazing animals return the

nutrients through defecation and urination. But this one has its demerit too in irregular distribution. That is why there could be irregular growth of rank and well grazed areas on pastures regularly grazed.

## **5. Loss of Nutrients from the soil**

This could occur as a result of fixation of elements in form not readily available to plants. Rapid mineralization occurs at the onset of rains after the dry season resulting in a flush of available nutrients especially N.

### **N Fertilization**

Most tropical soils are deficient in N and heavy applications are required to produce high yield of grass with high protein content.

*Response of grasses to applied N forage at and removed.* The practical objectives of carrying out N fertilizer trials under cutting conditions are:

1. To find the rates of applied N that optimize dry matter production at a level of favourably economic return and
2. To reduce the number of treatments that would need to be studied under as animal grazing conditions. In the figure above dry matter production increases almost linearly with successive increment of nitrogen fertilizer the increase being less pronounced beyond 1000 to 1200 kg/ha same grasses e.g. Molasses do not benefit much with N application.

Differences in response to applied N in terms of DM production are due to factors such as species, stage of grass amount and time N applied soil moisture and climate conditions. Response of established grass to applied N is dramatic in terms of increased DM production.

In northern Nigeria top-dressings of 50, 100 and 150 t/ha N boosted DM yields of *Andropogon gayanus* to 3550, 4140, and 4630 kg/ha/annum

respectively as compared to 133 kg/ha for zero N treatment. Yields of *Panicum maximum* were 3750, 5580, and 8500 kg/ha of DM with 0, 50, and 200kg/ha N respectively and the use 88kg/ha N versus nil doubled the yield of forage of *Chloris gayana*, *Cenchrus ciliaris*, *Setaria spacelata* and *Hyparrhemia rufa*. At Ibadan *Cymodon ruemfuensis* produced averages N as top dressing application. In addition, fertilizer N usually increase CP content but depress the P,K, Ca, and Mg contents of herbage due in part to dilution effect by increased herbage production. IT also decreased crude fibre percentage, improve tiller density and leaf area.

Effect of N fertilizer on grass-legume mixtures. The effect of fertilizer nitrogen on the proportion of desirable pasture component species is as important as boosting the yield of forge. Continued use of high N fertilizer causes a rapid decline in the legume component of tropical and sub-tropical grass legume combinations. The *Desmodium intortum* in established mixtures of *Peninsetum clandestinum* and *Digitaria decumbens* in Hawaii was reduced to less than 10% during the first year application of N as a minimum sulphate. The N was spilt into equal amounts top dressed at 5 week intervals. In contrast, the legume comprised 50% of both pasture combinations without N fertilization.

Competition for nutrients, water and light are major function influencing botanical composition in plant associations. Tropical grasses have more trend growth rate more aggressive than legumes. They also extract more N from the soil in all mixtures and are more persistence under frequent defoliation. Applied N reduces modulation of the legume which further interferes with its competitive capability. Grasses and legume generally have generally have different cycles of growth in terms of vegetative and reproductive phases. Their management in mixtures is therefore difficult and becomes complicated with applied N.

## **Cutting Management**

The interval between harvest of grasses and legumes greatly affects herbage production nutrition value, regrowth potential, botanical composition and species survival.. an extended period between cuttings has the following effects.

1. An increase in the percentage content of DM crude fibre, lignin and cell wall. With increasing plant maturity older leaves contain increasing cell wall constituents and thus reduced intercellular space as well as condensed cellular inclusions. In addition, midribs and leaf sheaths attain a greater percentage of fibre and lignin, older leaves senesce and lose water, stems elongate and less succulent.
2. An increase, then a decrease, or fluctuation in total dry matter production and nitrogen tred extracts.
3. A decrease in leaf stem ratio, percentages of crude protein mineral constituents (P, K, G, Mg) and soluble carbohydrates.
4. An increase, then a decrease in the amount of N uptake by the plant on N recovery.
5. A rapid decline in animal intake and digestibility. More mature herbage is less nutritive and thus less appealing to the grazing animal than juvenile and nutritious material. Digestibility declines as cell wall structure increases so that passage through the animal is slowed down. Increased DM yields with extended cutting intervals are consequently reduces, causes a decline in root development favour web invasion and adversely affect regrowth potentials.

## **Weed Control in pasture**

Pasture should be established with minimum weed population and some means of keeping weedy plants under control should be employed at all times. Invasion by weeds and shrubby species is always a sign of poor pasture management and usually results from inadequate fertilization and overgrazing of the desirable species. Many weedy species are highly adaptable to low soil fertility and readily invade and rapidly flourish under condition of overgrazing. The most effective and economic means of keeping weeds out of established pastures is to follow a regular programme of fertilization and judicious growing management practices. No matter how efficient the management strategies are some very aggressive weedy species still survive and persist and this calls for some very aggressive weeds include *Imperata cylindrical*, *Sporobolus pyramidalis*, *Paspalum fasciculatum*, *Paspalum conjugatum*, some cymbopogon species, sida species, mimosaspy etc., *Eupatoria consinnensis*, *synedrella nodiflora* etc.

Grazing management is about skilful manipulation of the two basic biological systems: the pasture sward i.e. the herbage available for grazing, and the grazing animal.

The main objective in pasture grazing management is to ensure long term animal productivity, by maintaining pasture stability, especially that of legumes which are most valuable and unstable compound of the system. Among the factors of grazing management that most affect pasture utilization are stocking rate grazing system and duration of rest and occupation periods in the rotation. In a livestock enterprise, the stock manager, attempts to regulate animal numbers so as to utilize a fluctuating supply of herbage effectively and efficiently.

## **Utilization**

Can be conceived as the efficiency with which the dry matter produced from a pasture is taken by the animal and converted to animal products. Pasture intake or utilization and animal production are related to the quantity of forage species present in the pasture. If all other factors in the figure below are held constant, animal production per unit area would be directly related to the availability of pasture.

### **Stocking rate**

Is the most important factor that influences forage utilization, by establishing a strong interaction between forage availability as a result of plant growth, and defoliation and intake of forages. The persistence of species in the pasture, especially of legumes is altered by the stocking rate and also varies according to morphological and physiological characteristics of the plants.

Stocking rate is normally expressed as number of animals per ha for a given time period. Since animals vary in size and in nutrient requirements a more precise measure the weight, or for comparing animals of different sizes the metabolic weight ( $W^{0.75}$ ) / ha. If a standard live weight is 300kg. Then a stocking rate of 2.1 =  $300\text{kg} * 2.1 = 630\text{kg}$ . the total weight of the animals to be used should be 630kg.

Grazing season is that portion of the year during which grazing feasible. It may be the whole year or just very short span within the year and is normally a function uncontrolled environment such as climate. In this context the vegetative growing season is only a part in the grazing season. Grazing period is that portion of the

grazing season during which grazing takes place. The beginning and end of the grazing period on each land unit are stipulated by the grazing system.

Continuous grazing is defined as unrestricted livestock access to any part of range throughout a grazing period. Continuous grazing is principally distinguished from other types on the basis that grazing occurs through the period when forage plants are growing.

Ungrazed signifies a brief period of non-use that is not scheduled specifically to allow seed maturation of seedling establishment.

Deferred grazing specifies that the vegetation is not grazed until seed maturity is nearly completely assured and that it is grazed after seed maturity.

Rest period is being used to explain that a pasture is not grazed at all in a given year. Even the mature forage is not harvested.

**Rotational grazing:** this system of grazing management is suited to intensive utilization of sown pastures. It is designed to obtain more uniform grazing of the pasture sward than continuous grazing. In most rotational grazing systems, the pasture is cross-fenced into paddocks and the herd allowed access to one until the herbage is uniformly grazed to a given height, the herd is moved into the second paddock. By the time the herd returns to the first paddock a uniform herbage growth should have developed. This system eliminates spot-grazing and ad mixture of mature and immature vegetation, as animals are forced to consume a major portion of the herbage. In an intensive system the rest period is used for fertilizing moving and irrigating if these are practiced.

**Leader-follower group**

In this rotational grazing system animals are divided into groups high producers (milk cows and fattening cattle) and low producers (dry cows and reserves). The higher producers enter a paddock first to graze the more nutritious top growth or about one-half the grazeable herbage. This groups remains on the paddock for 3-7 days. They are moved to a second paddock and followed by the second grazers to consume the residue left by the first grazers. In this way the higher – producing animals have access to the more nutritious and highly digestible portion of the herbage on offer

#### Strip or ration grazing

This an extreme form of rotation grazing. A grazing. A small section of the pasture is separated by an electric fence and the animal permitted to graze within the space defined by the fence. As soon as the herbage is grazed to the desired above ground level the fence is moved and another strip made available.

Often a second fence is moved behind to prevent grazing of re growth and maintain more even distribution excreta. The fence is usually moved daily. The system provides uniformly developed sward and allows near maximum utilization of herbage.

#### Fresh out and daily feeding.

This sometimes called green-chop ‘soiling’ or zero – grazing. Forages such as elephant guinea grasses etc are grown specifically for cutting as fresh herbage, transporting to penned livestock and feeding on daily bases. The difference in ‘green – chop’ and ‘soiling’ lies in the handling of the manure and feed residue. In soiling practice they are returned directly to the land where the forages is grown. With ‘green = chop’ they are not returned.

Grazing pressures - This is the number of animals per unit of available herbage representing an overall balance between the amount of herbage on offer and animal requirement. It is the rate of stocking at which animals fully utilize a predetermined amount of grazeable herbage. The term grazing intensity is used interchangeably with grazing pressure.

Carrying capacity- the number of animals per unit of land or stocking rate to give optimal daily rate of gain per animal and optimal live weight gain per unit area of land. The term grazing capacity is used interchangeably with C. c.

Animal days per unit area of land (hectare)

The number of animals per unit area of land multiplied by the number of days that animals are on the pasture. This is considered a measure of quantity of available or herbage yield.

Animal Unit

A standardized term sometimes used to describe the number of animals on pasture. One animal unit is considered a 2 year – old animal. A yearling heifer or steer weighing 275 – 320kg is equivalent to 0.75 au; a weaner calf (8 = 9 months old) weighing 160 = 200kg is 0.5 a calf of 4-8 months is 0.30, a ram or wether over one year is 0.20, a lamb up to 1 year, 0.15 units.

Defoliation of pastures species

Defoliation is said to mean removal of plant shoots by grazing animals or by cutting mechanically – knife, sickle, mowing, and machete. The plants shoot here means the plant leaves and branches and sometimes the main stem.

Defoliation has three important components as follows (a) frequency (b) Intensity (c) Timing.

Frequency of defoliation describes how often the plant shoots are removed. The interval between defoliation of forage species profoundly affects herbage production, nutritive value, regrowth potential, botanical composition and species survival.

Defoliation intensity explains how much plant material are left after defoliation or how much is removed. The degree of removal of leaf and stem materials by grazing the growing periods greatly affects the plants vigour, growth and reproduction. The grazing intensity of the plant materials is dependent upon (1) palatability (2) growth habit (3) digestibility (4) succulence (5) the physical characteristics of the materials and (6) its accessibility.

Intensive grazing will injure most plants in the pasture if it is severe and prolonged. The degree of injury is usually related to the frequency and degree of removal of photosynthetic plant organs.

This in turn reduces organic synthesis and plant food accumulation and storage. Recent studies have shown that grazed plants may be very severely injured by trampling or treading by the animals.

Where grazing without trampling was compared with grazing accompanied with trampling the yield of forage was reduced 20% by the trampling influence.

Trampling causes direct plant injury as well as soil compaction. The result could manifest in reduced plant tillers, slower shoot growth rate, change in botanical composition of the pasture due to differential plant injury, and reduced water absorption by the soil.

The extent to which different plants are affected by defoliation or grazing depends, in part upon;

1. The growth form of the plant, particularly in relation to location of food storage and reproduction by seed or vegetative means.
2. The proportion of living parts removed.
3. The frequency or severity of defoliation. The degree or severity of defoliation.
4. The quantity of reserve food in the plant at the time of defoliation. This will depend on previous growing conditions and the growth stage of the plant.
5. The inheritance or genetic make-up of the plant in relation to growth rate.
6. The growing conditions or growth environment following defoliation.
7. The side effects related to defoliation or grazing. Such as trampling injury, spread of plant diseases, effect of altering the micro-climate resulting in moisture loss etc.

Timing of defoliation is very important as it describes the stage of plant development and the climatic condition at the time of defoliation. The time vulnerable to defoliation include.

Early growth or re growth stage = may affect establishment

During period of water stress – may affect re growth

During flowering and seed setting = may affect seed setting and hence species that persist through seedling regeneration may be negatively affected.

Effect of Pests and diseases

Like pastures in other parts of the world and other field crops, tropical pastures have their complement of pests and diseases. Pests range from humans,

animals, insects, mites, nematodes and other primitives animals. Diseases may be caused by pathogens such as fungi, bacteria and viruses. Prevalence and severity of diseases of grasses and legumes have received little attention in the tropics and sub-tropics even though they create the media for development of a wide spectrum of fungi, bacteria, and aematodes.

Generally diseases of epidemic proportions have seldom occurred or were not reputed in tropical pastures. Periodic outbreaks of diseases or infestation of an insect on a regional basis have however occurred and caused pronounced local devastation to vegetations generally, including field crops.

Some of the fungi species that have been associated with forage plants include;

Anthcnose spp e.g.	In Stylosanthes spp
Piricularia spp e.g.	in Elephant grass
Helminthosporium spp	in Elephant grass
Xanthomonas spp	in Axonopus spp
Cercospora spp	in some Panicum spp
Claviceps spp	Guinea grass florets, melinis, <i>Brachiaria mutica</i> Paspalum

Some viruses and aphids have also been reported in tropical pasture plants. Pests and diseases in pasture may go unnoticed or the severity of their damage may not recognized by the casual observer. When yield becomes unusually low and no other satisfactory explanation can be advanced infection by some diseases may be suspected and decision taken if control is needed.

Control may involve the use of cultural methods – field sanitation, grazing tillage, rotational planting method, crop mixture, irrigation.

Chemical control methods may also be employed if the cost can be justified. Chemicals may include pesticides and nematicides. The use of resistant varieties

The use of resistant varieties may also be adopted, e.g. *Centrosema pubescens* (ILRI 152), *Stylosanthes guianensis* (ILRI 164) against leaf blight disease caused by fungi.