ANIMAL PRODUCTION

Level –III

Based on March, 2018, Version 3 Occupational standards (OS)

Module Title: Identifying and Organizing Animal Feed Resources

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East Africa Skills for Transformation and Regional Integration Project (EASTRIP)

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G # 33	**LO1 Assess feed resources**

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics –

- Assessing pasture and forage
- Identifying industrial by-products.
- Determining crop and crop residues.
- Assessing mixed feeds.

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, **you will be able to –**

- Assess pasture and forage
- Identify industrial by-products.
- Determine crop and crop residues.
- Assess mixed feeds

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
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9. d to the next learning guide,
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Information sheet 1- Assessing pasture and forage

Introduction

Livestock and their products have a central role in the economy of the mixed agricultural system. The mixed subsistent agricultural system is the most common form of agricultural in almost all parts of the sub-Saharan Africa and of course in Ethiopia. Livestock production in such agricultural systems particularly in tropical countries comes mainly from naural grass-lands. This fact holds true to Ethiopia, as well. The major source of livestock feed in Ethiopia is the forage that comes from natural grasslands.

Livestock production on the basis of extensive grazing of ruminants on natural pastures is an important fora of agricultural activity in many parts the country. The natural resources and potentials for extensive grazing of ruainants are large and still relatively underexploited, alt-hough there are some severe constraints in many areas of the country such as woodland cover, poorer quality grasses, tsetse fly and lack of a tradition of cattle raising**.**

Definitions

Grassland: - is defined as a natural land surface covered mainly by plants of grass family, herbaceous legumes and other herbaceous species (could be either natural or artificial).

Pasture: is a land occupied by perennial or annual forage species that are used as food by grazing animals.

Forage: - Fresh plant material used as feed for domestic herbivores. Forages can be broadly classified in the two Grasses and legumes

Grasses (Pasture)

Generally, grasses and its products is the main supplier of roughage in most countries with an advanced dairy-farming system. Pasture (grasses) provides a basis for dairy-production. They are abundantly available and with their good quality (usually) the cheapest source of food for cattle. Unfortunately, the quality of grasses in development countries can be rather

of poor quality. The availability may be limited due to land pressure (first priority is to provide staple food for human nutrition) and/or high production costs.

Primary pasture productivity

Primary pasture productivity as used here is defined as the total dry matter production (TDM) that can be expected from natural cleared grassland under rain fed conditions with no fertilizer or special management practices. It is normally measured in tons per hectare per year.

The poor quality is mainly due to:

1. Type of grass (varieties, species). Tropical grasses and natural grasses in temperate climates have often a lower protein content and the CF contents is (much) higher than in well managed special selected temperate grasses.
2. Maturity is usually reached earlier and flowering may be continuous, also due to climatic and soil factors.
3. Quality of grass is affected by management factors, such as:
    - Fertilizer input. Low or non N input results in lower CP contents and lower quantities of product.
    - Stage ad method of harvesting. Late harvesting (over-mature) provides more bulk but the product will be of poor quality (CF).
4. Method of conservation. Usually, warm and humid climates provide a rather poor environment for conservation (hay making, silage making), while similar factors contribute to losses during storage (mould due to moisture).

All in all, the net result often is a rather poor quality and yield. Grasses and its conserved products do have often a much lower digestibility and feeding value.

Growth habit of grasses

- **Tufted** - A cluster of single shoots arising from a single crown (*Panicum maximum*). The culms of tufted grass species may grow erect, in a decumbent fashion (curving upwards), semi-erect or semi-decumbent. The stems can even lie flat on the ground for some length.
- **Creeping** - Stems trail over or grow underneath the ground (e.g. *Cynodon* species).

- **Scrambling** - Most climbing plants are normally creepers but the stems will grow upward and over upright objects (e.g. *Pennisetum clandestinum*).

Legumes

Legumes are di-cotyledons with their embryo's containing two seed leaves (cotyledons). The roots of many leguminous plants become infected by bacteria of the species Rhizobium. These bacteria grow and multiply forming growths within the roots called nodules. The nodules differ in size, shape and arrangement on the roots.

The summarized 3 main functions of legumes are:

- To provide a nitrogen rich component to animal diets;
- To improve soil fertility;
- To stimulate growth of associated species (i,e, in multi or inter-cropping systems).

Examples: Annual: cowpea, cluster bean, desmodium
Perennial: lucerne, desmanthes

Growth habit of legumes

1. Bush type

The bush type is typified by a central stalk with side branches appearing along the main stem. Axillary branches also develop. Eg. Desmodium tortuosum.

2. Bunch type

A typical bunch type plant consists of a single crown from which several stems and new tillers arise. It is difficult to identify the main stem. Stems can be erect or decumbent.

Eg. Stylosanthes guianensis and Medicago sativa.

3. Creeping

Creeping stems of the creeping type trail over the ground surface. Some examples include Calopogonium mucunoides, Macroptilium atropurpureum and some Vigna spps.

4. Scrambling

The scrambling type is typified by creeping plants, climbing and growing over upright objects. Examples are *Centrosema pubescens* and *Pueraria phaseoloides*

Successful pasture establishment has three essential building blocks:

- Good soil conditions

- A properly adapted species
- Good weather.

The best one to start with is a well-adapted species.

Choose to plant a species that is:

- Well adapted to the soil pH
- The expected climate conditions (winter hardiness)
- Realistic drought or flood tolerance and
- Well suited to the intended use and livestock type.

Self-Check -1	Written Test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Annual forages are _____ (1pts)

   A. Life duration is < 1 year (one season) B. Good seeder (produce abundant seed)

   C. Fast establishing D, have long life span E. All except D are correct

2. What are growth habits of grasses? (3 points)
3. List growth habit of legumes (3 points)
4. List some advantages of legumes over that of grasses. (3 points)

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

You can ask you teacher for the copy of the correct answers.

Information sheet 2- Identifying industrial by-product

INTRODUCTION

The by-products that come from different agro-industries can be utilised for feeding of different classes of livestock. Agro-industrial by-products (AIBP) are mostly derived from agricultural processing industries such as cereal grain milling, oilseed extraction, brewery, malt production, fruit and vegetable processing and laughter Houses, Abattoirs, etc.
High moisture agro-industrial byproducts such as citrus, sugar beet and tomato pulp are of high nutritional value. In some countries these byproducts are given to animal fresh and/or after being sun-dried.

The by-products from these industries that can be used for feeding different classes of livestock include bran of different cereal grains, oil seed meals (cakes), molasses, brewer's grain and different slaughter house refusals like blood meal, bone meal, etc. Most of these by-products are concentrates of either plant or animal origin and rich in nutrients like carbohydrates, proteins and minerals. They are, therefore, utilized to supplement nutrients in ration formulation in combination with other feedstuffs.

B. Classification of By-products.

Agro-industrial by-products could be classified based on their origin as animal origin and plant origin by-products. They can also be classified into protein supplements and energy rich concentrates based on their crude protein contents. These latter form of classification is not different from the basic classification of feedstuffs in animal nutrition.

Table:1 Classification of Different Agro-Industrial By-products.

CLASSIFICATION	Energy Rich Concentrates (<18% CP)	Protein Supplement (>18 % CP)
Plant Origin	Wheat bran, Maize bran, Wheat short, Molasses, Brewer's grain, etc.	Oil seed meals, Oil seed cakes, Brewer's yeast, etc.
Animal Origin	Whey,	Fish meal, Meat meal, blood meal, etc.

C. Description of Selected Agro-industrial By-products.

1. Milling By-Product

Wheat bran: is the outer covering /pericarp/ of the wheat grain separated during pro cessing. Wheat bran contains higher amount of fiber and cannot be fed to poultry. But it is used as energy source for feeding ruminants. (CP content 8-18%, CF 14%)

Wheat short: This is the germ part of a wheat grain separated during processing. (CP 17%, CF 6-7%)

2. Sugar Industry By-products

Cane molasses: is a by-product of sugar industries, where the maximum amount of sugar is extracted from the juice of sugar cane. It contains 50-60% of soluble sugars (a mixture of sucrose, glucose and fructose) & high in energy. CP 3%, CF 0%, Crude Ash 10%. It is an excellent source of minerals except phosphorus.

3. Cane bagasse: is a highly fibrous residue of the cane sugar that remains after the juice is squeezed out. This is more like crop residues with higher amounts of fiber, which is equal to 36-42%. CP 2-4%, Ash 3%. It is of very low digestibility 20-40%.

4. Brewery By-products

Brewer's grain: is a byproduct of the malt culture, where the sugary liquid ("wort") is mashed out leaving the brewer's grain. This is used as a feed for farm animals either in wet or dried form. It is an energy rich concentrate containing about 17-18% CP and 15% CF.

Brewer's yeast: is the yeast used to ferment the wort and filtered off after the alcohol is removed. This by product is dried and sold as a brewer's yeast. It contains about 42% CP and it is a valuable source of B- vitamins & phosphorus but low in calcium. Brewer's yeast is a protein supplement with a very high digestibility that can be used to all classes of livestock.

5. Oil Industry By-products

After oil is extracted out of oil seeds, a protein rich by-product of great value as livestock feed is obtained. Oil seed cakes (meals), in general, are a very good source of protein, where 95 % of the nitrogen is found as a true protein. The digestibility of these meals is very much high at about 75-95%. They also contain relatively higher amounts of phosphorus but low in calcium.

Peanut (Groundnut) meal: is an excellent source of protein for all kinds of livestock including poultry. The CP content is 40-48% and CF content is about 13%. It mostly becomes rancid in warm and moist climates and hence should not be stored longer time

6 weeks, in such conditions.

Cottonseed meal: is a very good feed of high protein content (>40%). It is useful for both ruminants & mono gastric animals. CP 41-43%, CF10-14%.

NB. It contains a toxic substance known as Gossypol. But this can be reduced or destroyed by heating or by adding iron sulphate in the ration.

Soya bean meal: has the highest nutritive value of any plant protein source containing about 44-50% Crude Protein. It can be supplied to all classes of livestock including poultry. The anti-nutritional factors in the meal could be favorably destroyed by heat treatment.

Sunflower meal: CP 32-40% & CF 15-32%. The highly fibrous seed coat needs decortications. Due to high content of fiber this meal is useful only for ruminants.

Rapeseed meal: CP 36-40% & CF 13-14%. Only less than 5% inclusion for and swine, while not > 10% for ruminants.

Linseed meal: is a byproduct of oil extraction from flax seeds. These plant is mainly cultivated for its textile fiber and its seeds are used for oil production. The linseed meal has a depressing effect if it is fed in more than 5% rate in poultry rations. Soaking the meal in water for 24 hours can easily eliminate this toxicity of the meal. It is a satisfactory source of protein (35%) for almost all classes of livestock.

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided:

1. What are is the toxic substances found in cotton seed meal (2pts)

2. Mention the sugar industry by products used as animal feed sources (4pts)

3. Describe the amount of Crud protein contained in protein supplement and energy rich concentrates Agro-Industrial By-products.(2pts)

Note: **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

You can ask you teacher for the copy of the correct answers.

Information sheet 3- Determining crop and crop residues

Type, Feeding Potential & Limitations of Crop Residues

1. Crop residues

Crop residues are by products of grain, pulse & cereal crop production, which can be used as animal feed. These include Stover's, cobs, hulls, etc.

They are characterized with high fiber and lignin contents. But they are low with CP, calcium and phosphorus contents. Characteristically, they are believed to be low in their digestibility.

The low degree of digestibility of crop residues together with their low passage through the alimentary canal results in low voluntary intake. These conditions seriously limit the availability of net energy for production.

The potential for use of crop residues as livestock feed is greatest in crop – livestock farming system (mixed farming system). Because the availability of these materials is closely related with crop production and intensity of crop cultivation.

Although Ethiopia produces large amount of crop residues that can be used in supplementing animal diets, many of these by products are not efficiently utilized for livestock feeding. This is mainly due to the fact that adequate nutrient evaluation of crop residues has not been carried out & their economic benefits have not been realized.

Detailed inventory of crop residues and their identification does not exist in Ethiopia. However, a rough estimate of the amount of crop residues produced annually could be made from grain yields. This is possible by converting the grain yields of various crops in to the amount of crop residues produced using correction factors. The correction factors for various crops are shown below.

Correction Factors: wheat = 2.0 maize = 3.0 barley = 1.5 sorghum = 5.0, oats = 1.5, millet = 5.0, pulses = 4.0, oil (nuts) = 2.0, roots & tubers = 0.2. If, for example, the amount of grain produced from maize crop is equal to 750 kg then the amount of crop residue produced from this crop will be 750kg times the correction factor for maize (3.0) which will give 2250 kg. That means 750 kg ×3.0 = 2250 kg.

At the end the forgoing discussion, it is worth to note that neither crop nor livestock production can be maximized without due consideration of the interaction between crop and livestock production.

2. Nutritional Characteristics of Crop Residues

Low nutritive value: they are generally characterized by low nutritive value in that they have very low CP content & low digestibility.

Bulkiness: the bulky physical nature of crop residues does not allow easy pass through the alimentary canal & this results in lower voluntary intake.

High fiber content: the high fiber content of crop residues makes much of digestible carbo-hydrates that are found only in small amount not easily available.

3 - Factors affecting the Nutritive Value of Crop Residues

3.1. Species Difference:

Crop residues produced from different species crops have different feeding values. For example, course straws such as from millet, sorghum or maize are generally of better quality than the fine straws such as from wheat or rice.

3.2. Environmental Condition:

Conditions under which the crops have been grown have an effect on the quality of the crop residue. Lignification is greatly affected by environmental temperature. The higher temperature of the tropics promotes metabolic activity, which decreases the amount of metabolites in the cell. The drier the environmental conditions are, the better the forage quality of the residue is. Straws from barley grown in semiarid area will therefore be of better quality than that of barley grown in a more humid area.

3.3. Fertility of the Soil:

Fertile soil increases the quality of crop residues. Fertilized soils increase the nutritive value of the residue, as well. Addition of high amount of nitrogen will increase the amount of nitrogen in the straw & resulting in higher amounts of crude protein (CP) in the residue or straw.

3.4. Stage of Maturity: Plant species that remain vegetative either because of low temperature or genetic factors are almost always less lignified than those plants that develops to flowering stage under similar environmental conditions. Lack of flower or seed allows the

required resources to remain in the leaves and stems, which promote higher nutritive value. Therefore, poor grain production results in straws of higher nutritive value.

Improving the Nutritive Value of Crop Residues

To increase the nutritive value of crop residues, different treatment techniques are used.

Mechanical Treatment: this involves chopping, grinding, pelleting and chaffing in order to reduce the size of the crop residue.

Soaking of Straws: is also another method (physical) where straw when soaked for few hours before feeding (1 kg of straw in one kg of water) is believed to have a beneficial effect through removal of dust. At the same time the straw becomes soft. However, soaking of straws results in reduction of the dry matter.

Biological Treatment: this is a treatment using enzymes and bacteria to decrease the degree of lignin in the feed. But this is not a common practice in Ethiopia.

Chemical Treatment:

A. Alkali Treatment of Straws:

It has been observed that addition of 3.3 % of NaOH to crop residues improves the palatability and digestibility of the crop residues.

Solutions containing 50 gm NaOH/ 4lt of H_2O when added to a kg of straw removes significant amount of lignin.

B Urea Treatment:

The non-protein N content of fertilizer grade urea is 46.7 percent. Its formula is $CO(NH_2)_2$. It is decomposed into ammonia and CO_2 by urease at ambient temperature. Urease is an enzyme that converts urea into ammonia. The chemical reaction is:

$$CO(NH_2)_2 + H_2O \xrightarrow{\text{Urease enzymes. Ambient temperature}} 2NH_3/ + CO_2$$

Urea is widely used to generate ammonia for improving poor quality fibrous feeds

Procedures of crop residue treatment

1. Determine the amount of crop residues to be treated. This depends on:
    - The type and number of animals
    - Daily crop residue intake of animals

- Body weight of the animals
- Duration of feeding period

2. Prepare crop residues for treatment. This includes chopping the residues into pieces to about 2-10 cm long.
3. Determine the amount and size of packaging material requirement
4. Determine the amount of ingredients and prepare for crop residue treatment

   The standard procedure in the urea treatment is to use:
   - 4% urea (4Kg urea/100 kg straw)
   - Maximum of 1:1 = water: straw ratio
   - A treatment duration= Minimum 14 days and maximum 28 days

The standard procedure in the urea-molasses treatment is to use:

- 4% urea (4Kg urea/100 kg straw)
- Urea: molasses: water ratio (4kg urea: 10kg molasses: 80kg water)
- A treatment duration= Minimum 14 days and maximum 28 days

5. Properly stack or store the treated crop residue :

N.B.

- The treated straw must be exposed to open air for at least one hour to remove the small amount of ammonia gas before it is being offered to animals.
- The treated straw can be chaffed, mixed with a little green fodder & then be fed to animals.
- For efficient utilization of urea by the rumen microorganism, a readily available source of energy is essential to be fed along with the urea treated feed.
- Gradually increase the amount of urea treated feed to animals allowing some time for adaptation.

Factors essential for optimum use of urea

1. Mix the urea and straw thoroughly.
2. Feed urea to mature cattle, sheep and goat and not for mono-gastric and for young ruminants
3. Provide readily available energy source, such as molasses or grain or other sources of readily available starch.
4. Include adequate salt to increase palatability

5. Feed animals with only small amounts urea treated feeds and increase the amount gradually over a period of 5 – 7 days that allow animals to adapt urea treated feeds

Table.2. Nutritive values of straw before and after urea treatment

	Before	After
Crude protein	3–5%	7–10%
Digestibility	40–50%	45–55%
Intake		+20–40%

Self-Check -3	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Name…… ID…… Date…….

1. Mention Correction Factors of wheat, maize, barley and sorghum respectively (4 points)

2. Reason out why crop residue low in digestibility (4 points)

3. Discuss methods of improving nutritive value of low quality roughage.(4 points)

Note: Satisfactory rating – 12 points unsatisfactory rating –below 12points

You can ask you teacher for the copy of the correct answers

Information sheet 4: assessing mixed feeds

4.1. Introduction

Feed ingredient is a component part or constituent or any combination/mixtures added to and comprising the feed. Feed ingredients might include Grains, milling by products, added vitamins, minerals, fat/oils and other nutritional and energy sources. Animal foods provide a practical out let for plant and animal byproducts not suitable for human consumption.

The inclusion of forage legumes in low-input grassland mixtures is vital to improve biomass production, forage quality and ultimately soil fertility. Mixing legumes with grasses increases the CP concentration of the herbage mixture relative to that of grass monocultures.

4.2. Assessing pasture Quantity

- Good forage quantity is described as a condition where there is readily available amount material for grazing (proper plant height and plant spacing). The height of the forage is maintained between 3 and 8 inches during the pasture season.
- High quality forage is described as being high in protein and energy, and is easily digested by the animals.
- High quality forage is actively growing, lush forage (that is, it is in a vegetative phase of growth and has lot of green, leafy material).
- Low quality forage is slow growing, dry forage (that is, it is in a reproductive phase of growth, has mature seed heads, and contains a lot of stems compared with leaves). It is low in protein and energy, and is not very digestible - like straw).

4.3. The role of the legume in a mixed pasture sward

- legume have high protein content .they improve the palatability of a mixed grass-legume pasture by keeping the CP level above the critical level (7% of tropical species, 8.5% of temperate species) below which voluntary intake declines.
- Dry matter digestibility and voluntary intake of legume is generally higher than the grasses

- Legumes have high content of the mineral: calicum, sulphate, and phosphures , thus they provide stock with more balanced diet
- Legumes play an important role through symbiotic N fixation and the cycling of this nitrogen in to the pasture system

Self-Check – 4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

1. Which one of the following is not true about legume mixture in the feed of animal? (2pts):
   A. cycling symbiotic N and fixation
   B. low content of the mineral: calicum, sulphate
   C. make the CP level of pasture above the critical level
   D. All
2. The presence of legumes in pasture land helps for ____. (2pts)
   A. make the herbage balanced
   B. provide protein
   C. increase feed palatability
   D. improve soil fertility
   E. All

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Operation Sheet	Undertake crop residues treatment

Objectives:

To increase the nutritive value of crop residue:

Procedures of crop residue treatment

Step 1: Prepare the necessary materials and PPE

Step 2: Determine the amount of crop residues to be treated

Step 3: Prepare crop residues for treatment. This includes chopping the residues into pieces to about 2-10 cm long.

Step 4: Determine the amount and size of packaging material requirement

Step 5: Determine the amount of ingredients and prepare for crop residue treatment

Step 6: Record and report you observation and finding to your instructor.

Hint

The standard procedure in the urea treatment is to use:

- 4% urea (4Kg urea/100 kg straw)
- Maximum of 1:1 = water: straw ratio

LAP Test	Crop residue treatment

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Use personnel protective equipment,

Given necessary templates tools and materials you are required to perform the following tasks within **2** hours.

Task: Perform crop residue treatment

LG # 34	LO2. Establish and develop pasture and forage program

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics –

- Preparing pasture and forage establishment program
- Determining total pasture capacity.
- Assessing fodder crop production potential
- Determining performance targets for growth
- Selecting pasture species to deliver planned land use
- Selecting grass and legume components in pasture mix
- Corry out pre-treatment of seed.
- Selecting sowing methods for pasture species
- Applying fertilizers.
- Selecting machinery and equipment

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, **you will be able to –**

- Prepare pasture and forage establishment program
- Determine total pasture capacity.
- Assess fodder crop production potential
- Determine performance targets for growth
- Select pasture species to deliver planned land use
- Select grass and legume components in pasture mix
- Corry out pre-treatment of seed.
- Select sowing methods for pasture species
- Apply fertilizers.
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Information sheet 1- Preparing pasture and forage establishment program

1.1. Improved forage and pasture production strategy

In many of potential areas of the country dairy production has been intensified due to development interventions encouraging intensification and the interest of farmers to intensify, while there is insignificant production of improved pasture and forages. Livestock feed resources in Ethiopia are mainly natural grazing and browse, crop residues, improved pasture, forage crops and agro-industrial by-products.

Grazing lands have been degrading due to growing pressure on land resources from increasing populations and greater cropping intensity. Crop residues are also poor quality feed resources which could not provide nutritional requirements of the animal.

Furthermore, costs for industrial by-products is too expensive for smallholder dairy farmers to afford. Producing improved forages can help dairy farmers to withstand the prevailing feed shortages in different parts of the country. In dairy systems where feed scarcity is challenging, improving feed supply is possible if backyard forage production, under-sowing, over sowing and growing improved pasture and forages are widely adopted.

2.1. Forage production strategies developed by fourth livestock development program (FLDP)

Forage development strategies enable farmers increase the supply of animal feeds both in quantity and quality. Apart from increasing animal feed supply, these strategies enable to reinforce the traditional linkage between livestock and crop production (for example, inter-cropping). They promote sound soil and water conservation in denuded and bare grazing lands. However, this does not mean that all forage development strategies can have these benefits equally nor does it mean that they can be promoted under any circumstances. Each of these strategies has its own area of application.

The strategies developed and successfully implemented by the FLDP in Ethiopia evolved from experiences in other countries and an understanding of the importance of matching forage systems to AEZs. The strategies are farmer centered and were developed with farmers

to maximize sustainable income generation and food production at the household level. The key forage production strategies are conservation based and promote the use of legumes as improved forage. The key strategies are divided into **two** categories

I. **On Farm Strategies**
   - Backyard Forage Production
   - Under sowing and Inter planting
   - Contour Forage Strips
   - Agroforestry

II. **Common Land Strategies**
   - Over sowing Common Grazing Areas
   - Stock Exclusion Areas/Forage Banks
   - Permanent Pastures

Backyard Forage Production

Backyard forage production is based on small plots and hedges of productive forage and browse planted within house compounds and around their boundaries. This is the most important initial strategy since it is developed in the farmer's household, and is very convenient for intensive feeding of dairy animals or fattening of meat animals.

The higher fertility levels typically found in and around house compounds also help with the successful establishment of backyard forage. This strategy has a major impact in exposing farmers to the management and productivity of new species and also provides a seed bank to help establish new plantings for other forage strategies.

of farmers very quickly and can therefore have a great impact nationally, even in the short term. Demonstrations of about 100 browse legume.

Under sowing and Inter planting

Under sowing and inter planting is the establishment of forage species in an annual crop or perennial plantation.

The under sown forage protects the soil from erosive rains, can contribute nitrogen for the food crop, and balances the forage value of crop residues such as Stover and straw to increase its intake and utilization. The strategy works well with sprawling and climbing legumes but is also effective with other forage legumes and dual purpose legumes such as cow pea.

Contour Forage Strips

Forage strips are broad based mixtures of herbaceous and tree legumes, and grasses planted on contour bunds or in narrow strips along the contour without any physical structures. This is a multipurpose strategy providing forage, shelter, soil stabilization, and fuel wood. Forage strips planted along the contour contribute to soil conservation by directing ploughing along the contour and by reducing run-off down the slope.

Agroforestry

Agroforestry involves a close association of trees or shrubs with crops, animals and/or pasture. Specifically, it is the deliberate combination of trees with crop plantation or pastures, or both, in an effort to optimize the use of accessible resources to satisfy the objectives of the producer in a sustainable way. Agroforestry is the combination of trees and agriculture in an integrated and sustainable farming system.

Over sowing common grazing areas

Over sowing is the simplest of the forage development strategies and can be undertaken at very low cost depending on the seeding rates used. It involves broadcasting or sowing improved forage species into common grazing lands, native pastures and degraded areas without any cultivation or other inputs.

Stock Exclusion Areas/Forage Banks

Stock exclusion areas are an important means of protecting degraded areas, key watersheds, and common land. They also provide an opportunity to develop forage banks for use during droughts or periods of seasonal forage shortage.

Permanent Pastures

Permanent pastures comprise a broad range of annual and perennial legumes and perennial

grasses. Productive mixed pastures can be readily established, particularly in the low and medium altitudes with warmer growing conditions.

Roadside Sowing

Roadside sowing is a successful means of implementing the oversowing strategy. It is quick and effective and provides an impressive visual impact which can be used to excite farmer interest and provide an incentive for the formation of grazing management groups or pastoral associations. This strategy can be highly cost-effective, particularly when using species with the ability to spread under grazing

Aerial over Sowing

Aerial sowing enables very large areas to be overs own with improved forage seeds. The success of establishment depends largely on the selection of suitable sites.

Cereal/forage crop rotation

This system involves introducing annual forage legumes into the traditional cropping pattern. In the central highlands, to which the system is more applicable, the cropping sequence is cereal-cereal pulse. In between any two cereal crop phases, annual fodder crops like clovers, medics or lablab may be sown, harvested and conserved as hay for strategic feeding during the dry season

Sequential cropping

Sequential cropping is practiced when two crops (forage and pulse) are grown during a season, one after the other. The essential feature of this system, known as sequential or double cropping, is that the two crops do not overlap, the second being sown only after the first crop is harvested. This cropping is incorporated between any two cereal crop phases according to the traditional crop rotation.

Self-Check – 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

1. Mention the importance of back yard forage development (2pts)
2. mention **the two** categories key strategies used in forage development program (5pts)

Note: **Satisfactory rating - 7 points** **Unsatisfactory - below 7 points**

You can ask you teacher for the copy of the correct answers.

Information sheet 2- Determining total pasture capacity

2.1. Introduction

When pasture mass/ capacity is assessed, stock numbers can be managed to increase the utilization of available pasture as long as the quality and quantity is at or above the minimum benchmark for that class of livestock or performance level. Pasture quality directly influences animal intake and production. This occurs in two ways: by influencing the amount of pasture consumed; and through determining how much of the feed consumed is converted into animal product. There is no single measure of pasture quality. It is a combination of the proportion of legume, green and dead material, and digestibility – all of which affect pasture energy content. Pasture energy content is the main driver of animal production and is measured as mega joules (MJ) of metabolisable energy (ME) per kilogram of dry matter (and is related to digestibility of the pasture). The higher the quality (and therefore energy content) the less the amount animals need to eat to achieve the same growth rate or level of milk production

2.2. Carrying capacity:

This is defined as the number of animals that can graze in a unit of pasture without over-grazing or under grazing in an average season.

Seasonal fluctuation in forage production must be considered to determine the carrying capacity of a pasture.

2.3. Determining the optimum stoking rate

Proper socking rate refers to limiting of the number of animals, which can be grazed in a given area of pasture or range.

Optimum Stocking Rate = Carrying Capacity

The number of animals an enterprise can carry will be influenced primarily by:

- pasture growth rate and growth patterns
- preparedness to use supplementary feed, and
- Nutrient requirements of each class of animal.

Critical information for decision-making about carrying capacity includes:

- annual pasture growth rate curve and variation across the farm
- likely variability in pasture growth curves over time based on historical weather data
- metabolisable energy value of the pasture when plant growth stage changes
- energy requirements for each class of livestock at each physiological state
- minimum energy content of grass that will meet the energy requirement for each class of livestock
- management strategies applied to the breeding herd (timing of calving and weaning, culling strategies, selling ages)
- Fodder conservation and supplementation strategy.

There are six main factors influencing optimum stocking rate.

1. The rate of forage growth

The amount of forage growth depends on whether there is favorable climate present or not. Where there is favorable climate, high stocking rate may be employed consistent with improved pasture management practices that result in high rate of forage growth and dry matter accumulation

2. Accessibility of forage to animals

This may be limited by

- the problem of predators and theft
- the distribution of watering points in the pasture

3. The nutritive value of pasture

If high stock rate is employed on pasture with poor nutrient value, animals ingest high proportion of stem which cause a reduction in their performance

4. Botanical composition and ground cover

Heavy grazing due to use of high stocking rate may result in the following consequences

- favor shade intolerant species
- cause invasion of weed

- cause erosion hazard

5. Seasonal variation in feed supply

Pasture growth varies with climatic condition especially rainfall. Thus, when deciding optimum stocking rate, consideration must be given to:

- the period of lower feed supply
- the amount of surplus feed for conservation

6. Nature of animal product

- the sensitivity of the output to nutritional stress determines stocking rate

E.g. dairy animal providing milk is more sensitive than beef cattle providing us meat.

Deterioration of pasture begins when undesirable species replace the valuable forage plants .Improvement of such deteriorated pasture includes protection of land for optimum period to allow establishment of new seedling, control of animal number and relief from overgrazing. Desired vegetation can also be restored by seeding degraded pasture with suitable grass and legume species. Protection of pasture and controlled grazing alone increase the carrying capacity of pasture almost two to three times. Pasture can be improved by adopting the following techniques:

1. Fencing
2. Adoption of soil and water conservation measures
3. Re-seeding of pasture
4. Proper fertilization
5. Use of legumes forages in pasture land
6. Weed and bush encroachment control
7. Proper grazing management
8. Pest control

Self-Check – 2	Written test

Name…… ID…… Date…….

Directions:

Part I. Answer all the questions listed below.

1. Define carrying capacity of pasture land (2pts)
2. What is grazing management? describe the relationship between plant, animal and human being ?(5pts)
3. Mention the techniques to be adopted to improve pasture.(5pts)

Part II. Choose the best answer.

1. Which one of the following is **incorrect** about the consequences heavy grazing? (2pts)
   A. favor shade intolerant species
   B. cause invasion of weed
   C. cause erosion hazard
   D. favor shade tolerant species

Note: **Satisfactory rating - 14 points** **Unsatisfactory - below 14 points**

You can ask you teacher for the copy of the correct answers.

Information sheet 3- Assessing fodder crop production potential

3.1. Introduction

Fodder crops are crops that are cultivated primarily for animal feed. By extension, natural grasslands and pastures are included whether they are cultivated or not. Fodder crops may be classified as either temporary or permanent crops. The former are cultivated and harvested like any other crop. Permanent fodder crops relate to land used permanently (for five years or more) for herbaceous forage crops, either cultivated or growing wild (i.e. wild prairie or grazing land), and may include some parts of forest land if it is used for grazing. Temporary crops that are grown intensively with multiple cuttings per year include three major groups of fodder: grasses, including cereals that are harvested green; legumes, including pulses that are harvested green; and root crops that are cultivated for fodder All three types are fed to animals, either as green feed, as hay, i.e. crops harvested dry or dried after harvesting, or as silage products. Silage, or ensilage, refers to green **f**odder preserved without drying by fermentation that retards spoiling.

Grasses contain crude fibers, crude protein and some minerals. Legumes are particularly rich in proteins and minerals. Root crops are high in starch and sugar and low in fiber, making them easy to digest. The fiber content of most fodder crops consists of cellulose, a complex carbohydrate polysaccharide that is indigestible for humans, but which is a good source of energy for animals, and particularly ruminants.

3.2. Fodder Crops

The most common fodder crops are: roots, beets, carrots, cassava, turnips, swedes, mangolds, tubers (sweet potatoes, vines, and potatoes), fodder grains (maize, sorghum, oats, rye) and Brassica species (kale, cabbages, rape). The main advantage of these fodder crops is, that they are capable of producing high yields per/ha, often during periods when other roughage (grass) are in short supply. Frequently they are produced on irrigated land and can be fed fresh or conserved (maize silage), while some products can be relatively easy stored (tubers, roots).

3.2.1. Roots, tubers and Brassica species

These species have a low DM% (10-20%) and are relatively rich in energy, supplying nutrients like starches and sugars. Their CF content is low which results in a high digestibility (and palatability). Their protein content is generally low, as well as their mineral/vitamin contents with the exception of carrots, which are rich in vitamin A.

3.2.2. Fresh/green fodder crops

These crops provide a welcome component in a diet, especially where dried roughage and concentrates are prevailing. Care should be taken with the laxative effect these fodder crops generally have, which may cause diarrhoea (introduce gradually) and may depress the fiber digestibility of other components of the ration.

3.2.3. Fodder grains

Those which can give high yields: relatively energy rich roughage per unit land. The feeding value depends largely on the quantity and maturity of the seeds included. Sometimes, seeds are harvested for human consumption. This reduces the feeding value of the remaining plant. The protein content is relatively low. Maize is an excellent product for silage making, sorghum can provide several cuts of fresh material (irrigation and cutting at immature stage).

Sorghum should not be grazed during the first 3-4 weeks after cutting. Sorghum may contain a rather high amount of prussic-acid in the young stage, causing poisoning (death)

Self-Check – 3	Written test

Name…… ID…… Date…….

Directions

Part I. Answer all the questions listed below.

1. Define fodder crops (2pts)
2. What are permanent fodder crops? (2pts)

Part II. Choose the best answer.

1. Temporary crops that are grown intensively with multiple cuttings per year include major groups of fodder (2pts):

   A. Grasses, including cereals

   B. Pulses that are harvested green

   C. Root crops that are cultivated

   D. All

1. The feeding value of fodder crop depends largely on the quantity and maturity of the seeds included. (2pts)

   A. True B False

Note: **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

You can ask you teacher for the copy of the correct answers.

Information sheet 4- Determining performance targets for growth of pastures and crops

4.1. Pasture growth period

Pasture growth drives productivity in grazing enterprises, so an understanding of the different pasture growth periods throughout a year is essential for producers wanting to maximize pasture utilization and ensure pastures don't deteriorate.

In some type of climates, the three pasture growth periods for annual-based pastures are: establishment, vegetative and reproductive. A fourth period, senescence, is a period where pasture dies or 'hays off' with a rapid decrease in the amount and quality.

4.4. Estimates of pasture growth rate

Unless otherwise stated, the estimates are for expected availability of feed of adequate quality and are based on: pastures or pasture mixes with a good balance of legumes, grown on suitable soils pastures that are well managed to be maintained in the active growth phase so that quality is at a high level soil fertility is non limiting. using some form of rotational grazing to enable pastures to rest and grow between grazing events growth rate of the pasture, stocking rate, degree of wastage through trampling and fouling and the previous management of the pasture. In any period, the pasture type is capable of growing pasture mass of adequate quantity and quality to suit the requirements of seasonal conditions

4.5. calculating Pasture Growth Rates

It is important to have pasture growth information for your farm for strategic planning (e.g. annual feed budgeting, identify underperforming paddocks) but also for tactical management (e.g. predicting a surplus situation)

Pasture growth is measured in kg DM/ha/day. Growth rate data is available for different regions however these are best used as a guide for strategic planning.

Working out the growth rates for your farm requires good record keeping. In most cases, software available for feed wedges and pasture data can calculate growth rates at a farm level. The method below will allow you to calculate pasture growth rates at a paddock level

How to work out growth rates

- Measure grazing residuals for each paddock e.g. 1,500kg DM/ha
- Measure again before grazing e.g. 2,800 kg DM à 1,300 kg DM pasture grown since last grazing.
- Divide this by the number of days between measurements e.g. 24 days
- The average growth rate is 54 kg DM/ha/day

What you need: a board or spreadsheet to record each grazing date for each paddock and to record the corresponding pre-grazing and post-grazing cover.

This information can then be used as a guide for the next grazing round (and following seasons). Saving this information will allow you to build up a file of data that can be used for feed budgeting purposes.

4.3. Pasture establishment

Pasture establishment occurs after the break of the season in autumn/early winter. It describes the period from germination and seedling emergence, to the point where the seedling has developed a root and leaf system that can sustain being grazed.

Successful pasture establishment is vital to ensure the persistence of annual pastures. Grazing a pasture too early after seedling emergence can dramatically affect pasture establishment due to:

- Uprooting of small seedlings resulting in reduced plant density which is the single biggest determinant of early growth rate
- Removal of leaf area (defoliation) resulting in reduced growth of seedlings, poor root development and poor drought tolerance.

Decreasing the grazing pressure, applying fertiliser (particularly nitrogen on grassy pastures), or sowing pasture seed can improve plant density and effective pasture establishment.

Grazing pressure during autumn/early winter can be reduced by supplementary feeding which reduces the amount of daily pasture intake as animals fill up on supplement. Deferred grazing, where animals are removed from the pasture, allows seedlings to establish better compared

to grazing through the break which can lead to substantial loss of seedlings. Grazing establishing pastures also keeps, thereby reducing leaf area index resulting in poor root development and poor drought tolerance.

4.6. Vegetative

Vegetative pasture growth describes the summer period where plants have become established and are mature enough to withstand being grazed and defoliated by animals.
During this stage, pastures are actively growing and stocking rates can be maximised. However, over-grazing by grazing animals can result in insufficient leaf area for maximum pasture growth. Small plants may have poorer root development and are more susceptible to cold stress in winter, further reducing growth.

General rule: higher leaf area = faster pasture growth.
.Grazing during the vegetative pasture phase is important to:

- Encourage tillering in grasses and branching in clovers
- Assist in weed control
- Maintain palatability of the pasture by promoting young shoot growth.

Clover seedlings with four to six leaves are generally able to tolerate a moderate grazing pressure. Clover leaves, flowers, burrs and seed all originate in the axils (branches) of leaves along the main stem. Since grazing stimulates branching until flower initiation, the aim up to the point of flowering is to graze clover pastures to maximise the number of branches per plant and, in turn, maximise the potential seed production.

Early growth of grasses can be increased with the application of nitrogen fertilizers to grass-dominant pastures, although the response tends to be site and season dependent. This boost to pasture growth may allow an overall increase in stocking capacity.
Grazing management through the vegetative period should aim to meet animal production objectives, while being sensitive to the productivity and sustainability of the pasture. This can be achieved through various grazing tactics, including strip grazing, and grazing to a paddock target.

Self-Check – 4	Written test

Name…… ID…… Date…….

Directions

Part I. Answer all the questions listed below.

1. Mention the importance of grazing during the vegetative pasture phase(3pts)
2. what is the importance of knowing pasture growth periods?(2pts)
3. explain why grazing a pasture too early after seedling emergence can dramatically affect pasture establishment,(4pts)

Note: **Satisfactory rating - 9 points** **Unsatisfactory - below 9 points**

You can ask you teacher for the copy of the correct answers.

Information sheet 5- Selecting pasture species to deliver planned land use

Seasonal growth patterns of forage may include annual and perennials based on life forms. Annuals complete their life-cycles in one year while perennials survive for more than two growing seasons. Each stem of annual grasses bears an inflorescence.

Perennial grasses also bear inflorescences but may also produce vegetative tufts which may flower within two or more years. In the tropics grasses and legumes tend to be annual or perennial. The growth of an annual starts and finishes within one year while perennials exhibit cyclic patterns of growth.

I. Annual

- Life duration is < 1 year (one season)
- Good seeder (produce abundant seed),
  - ✓ survival mechanism
  - ✓ Overcome hard season.
- Fast establishing
- Low persistence (do not stay productive for long period)
- Best utilized as fodder crops, i.e. crops grown for one season & harvested for hay or silage.
- Low level of nutrition, but depends on type of species
- Are pioneers in degraded land (the 1st in plant succession)

  Examples;

  - ✓ Oats (*Avena sativa* L.)
  - ✓ Vetch (*Vicia dasycarpa* L.)

II. Perennials

- Survive from 1-3 years or more
- have long life span (are more persistence, give production for longer time)
- seed production- low when compared to annuals

- ✓ Cocks foot (Orchard grass) (Dactylis glomerata L.)
- ✓ White clover (Trifolium repens L.)
- ✓ Buffel grass (Cenchrus ciliaris L.)
- ✓ Colored Guinea grass (Panicum coloratum L.)
- ✓ Elephant grass (Napier grass, English or Zihone sar, Amharic) (Pennisetum purpureum)
- ✓ Rhodes grass (Chloris gayana)
- ✓ Para grass (Brachiaria mutica (Forsk.) Stapf)
- ✓ Guinea grass (Panicum maximum)
- ✓ Green leaf (Desmodium intortum)
- ✓ Common stylo (Stylosanthes guianensis (Aublet) Swartz)
- ✓ Lucerne (alfalfa) (Medicago sativa L.)

When selecting plant species for seed production it is important to consider their life cycles (annuals vs. perennials) and the land use system not to be occupied by crops.

- Annual legume have a better chance of growing in drier climates than perennial legume species as long as the wet season is sufficiently long and reliable to complete seeding
- In annual species seeding is synchronized and hence easy to manage and harvest
- Annuals are suitable where there is a distinct wet and dry season
- Perennials cannot survive in drier environments with short growing seasons
- However, annuals cannot respond to out of season precipitation as the moisture may not be reliable and long lasting
- Perennials give a longer sequence of seed production than annuals.

Self-Check – 5	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

1. Mention the difference between plant diversity and plant cover (3pts)

2. In a pasture mix, the pasture comprise at least how much percent legume of total air-dry weight of forage (3pts**)**

Note: **Satisfactory rating - 6 points** **Unsatisfactory - below 6 points**

You can ask you teacher for the copy of the correct answers.

Information 6 - Selecting grass and legume components in pasture mix

6.1. Percent desirable plants

This indicator determines if the pasture has the kind of plants that the livestock on it will graze readily. A desirable species is readily consumed, persistent, and provides high tonnage and quality for a significant part of the growing season. Undesirable species, such as woody invaders, noxious weeds, and toxic plants, are those that typically are not eaten (rejected) by most livestock or cause undesirable side effects when eaten, and that crowd out more desirable species.

6.2. Plant cover

The percentage of the soil surface covered by plants is important for pasture production and soil and water protection. A dense stand (high stem count) ensures, when properly grazed, high animal intake and high sunlight interception for best forage growth. Bare, open spots allow for weed encroachment, increased water runoff during intense rains, and soil erosion. Visually estimate the total cover of all desirable and intermediate species. Assign a value based on either green leaf canopy or live vegetative basal area cover percentage. Use the most familiar method that provides a consistent, reliable estimate of plant cover for the pasture being rated.

6.3. Plant diversity

Plant diversity is the number of different forage plants that are well represented (20% or more of plant cover) in a pasture. Low species diversity causes season-long pastures, or a set of pastures grazed as a unit, to be less reliable suppliers of forage to livestock during the grazing season. Forage production varies more widely through the grazing season because of changing weather and light conditions and insect and disease pressure.

Pastures that have high species diversity tend to be older, moderately 5.1.grazed permanent pastures. Here planted and volunteer forages have adjusted to the management and the pre-

vailing environmental stresses. No single forage species is so dominant as to crowd out others. Having more than one functional plant group growing either in a pasture or in different, complementary pastures is highly important. This maintains the most consistent forage supply during the grazing season. Functional groups of forages are plant groupings that have similar growth habits and management needs.

The four basic functional groups for improved pastures are cool-season grasses, warm-season grasses, legumes, and other grazable broadleaf plants (e.g., Brassicas and forage chicory).

6.4. Percent legume

Legumes are important sources of nitrogen for pastures and improve the forage quality of a pasture mix when they comprise at least 20 percent of total air-dry weight of forage. Deep-rooted legumes also provide grazing during hot, dry periods in mid-summer. Visually estimate the percentage of legume present in the total forage mass. Rate this indicator even if site or grass species preclude successful legume establishment and reliable survival to have an effective legume component to fix nitrogen. Most pastures are nitrogen limited since much of the nitrogen excreted by animals eludes plant uptake. Pastures with few or no legumes present need alternative means of supplying nitrogen for optimum forage production. When bloating legume content is greater than 60 percent of total forage dry weight; bloat incidence in livestock is likely without preventative steps

6.5. Plant residue

Plant residue, in various states of decay, provides additional surface cover and organic matter to the soil. However, too much standing dead material in the grass stand reduces the feed value of the forage consumed and animal intake, and inhibits new plant shoot growth. Excessive amounts of standing dead material may cause the forage to be rejected by the grazing animal. Less than 25 percent of the standing forage mass should be dead or dying leaves and stems. Buildup of thatch (mat of undecomposed residue) at the soil surface indicates retarded residue decay. Thatch promotes fungal diseases and retards or prevents shoot and seedling emergence. This results in forage stand decline.

Self-Check – 6	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

3. Legumes are quality forage of a pasture mix when they comprise at least _____% of total air-dry weight of forage (2pts)

4. The percentage of the soil surface covered by plants is important for _____ production and _____and _____ protection. (3pts**)**

5. Plant residue, in various states of decay, provides additional _____ and _____to the soil (2pts)

Note: **Satisfactory rating - 7 points** **Unsatisfactory - below 7points**

You can ask you teacher for the copy of the correct answers.

Information sheet 7. Carry out pre-treatment of seed.

7.1. Introduction

Different legume forage seeds have hard or waxy seed coats that inhibit the absorption of water. These seed coats due to inhibition of water absorption mostly prevent germination of seeds. Therefore, the seed coat must be broken or scarified before sowing of such seeds.

Various techniques are used to improve the germination rate of these hard coated forage seeds. These techniques include the hot water treatment, mechanical scarification & sulphuric acid scarification.

Pulse legumes have low proportions of hard seeds and do not require seed treatment. The herbaceous & tree legumes have varying proportions of hardness with highest levels in stylos(seca & verano) and leuceana.

7.2. Seed treatment techniques

The Seed treatment techniques are Physical, Chemicals and Biological

Different types of seeds require different treatments for optimal germination. The main purpose is to break their dormancy in order to improve seed flow characteristics, allow rhizobium inoculation and protective chemicals to surround the seed. There are different methods of reduction of seed hardness. These include:

- Hot water treatment or scarification
- inoculating legumes
- Acid treatment

Hot Water Treatment

Procedures:

1. Boil a container of water.

2. Remove the water from the heat source & immerse the seed wrapped with a cotton cloth.
3. Soak the seed for 5-10 minutes depending upon the type of seed.
4. Rapidly cool seed by spreading it out in a thin layer (not more than 10mm thick) or soak in cold water- overnight.

Scarification: is defined as any process of scratching the seed surface. Such scratches might not be visible but they allow absorption of water by the seed surface to enable faster germination of the seed

Scarification treatments are employed prior to sowing to abrade the seed coat and improve permeability, e.g., most legume and some grass seeds such as *Cenchrus, Melinis,* and *Paspalum notatum* require scarification

Methods of mechanical scarification include:

1. Placing the seed with gravel in a cement mixer and rotating it for at least 30 min.
2. Rubbing seeds on abrasive surface, like concrete or sand paper.
3. Passing seed through a hammer mill or using a specially designed scarifier with a rotating abrasive disc.

A major advantage of mechanical scarification is that it can be mechanized to treat large quantities of seed rapidly.

Acid Scarification

This technique is mostly used for small experimental samples.

1. Immerse a well dried seed in a concentrated H_2SO_4 for 5 minutes.
2. Immerse a seed, after wards, in a large volume of water.
3. Acid scarification has the advantage of killing any disease organisms on the surface of the seed.

After it is thoroughly dried the seed treated in hot water treatment or acid scarified can be stored for 1-3 months in a cool and dry seed store.

Other Important Seed Treatment Techniques

Legume seeds are sometimes inoculated with the type of bacteria /rhizobium bacteria/ necessary to ensure the early supply of nitrogen for the growing plant.

Seed inoculation is a simple process, where the inoculum is mixed with seed in water. The seed is then dried under a shade since sunlight kills rhizobia. Since insecticides also kill rhizobia, seeds treated with insecticides should also be dried for several days before inoculation. Inoculated seeds should be sown immediately into a very moist seedbed.

Storage: Holding freshly harvested seed in storage will overcome dormancy problems since dormancy declines with time. Storage is often applied to grass seeds

In case of grass seeds, one important pre-sowing precaution is to age the seeds. Ageing of freshly harvested grass seeds is very much important to facilitate germination. Most freshly harvested grass seeds are temporarily dormant and will not germinate at sowing.

Thus, they must be stored for 6 months after harvest before they are ready for sowing.

Self-Check – 7	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

1. mention the most important seed treatment techniques (2pts)

2. Define mechanical scarification. (2pts**)**

3. Legume seeds are sometimes inoculated _____ necessary to ensure the early supply of nitrogen for the growing plant. (2pts)

Note: **Satisfactory rating – 6 points** **Unsatisfactory - below 6 points**

You can ask you teacher for the copy of the correct answers.

Information sheet 8. Selecting sowing methods for pasture species

8.1. selecting sowing methods for pasture species

Sowing practice

a) Timing:

The most desirable time to seed non-irrigated areas is immediately before the season of the most reliable rainfall, and when temperature is favorable. Sow perennial species at the onset of the longest wet season when the soil has received sufficient moisture to support germination and establishment. The best seeding date depends on the area of the state, soil moisture and whether grasses or legumes are being seeded.

- **Grasses**: sown after the rainy season because grasses need continuous soil moisture for optimum development and do not have storage organs to stay any longer.
- **Legumes:** sown within one month before the small rainy season because they have got storage organs.

b) Spacing: Generally, spacing between rows should not exceed 25–45 cm and within-row plant spacing should be 5–15 cm.

c) Sowing depth: Generally, the smaller the seed the shallower the depth of planting. Usually, grasses are sown at the depth of 1–1.5 cm, while medium-sized legume seeds are sown at a 2.5 cm depth. This is usually related with seed size, seeding emergency, and survival of small seeded species. The optimum depth of:

- Most grasses and small-seeded legumes lie between 1 to 3cm, but varies according to species or cultivars and care should be taken.
- The largest seed of legume placement between 3-5cm below the soil (like leuceanea, susbania, cowpea, lablab) and
- The smallest seed not more than 0.5cm.

8.2. Method of sowing – there are three methods of sowing or planting of seeds. these are :

1. Row-sowing
2. Broadcasting
3. Spot seeding

8.2.1. Row-sowing

This is the preferred type because it offers the following advantages:

- Low seed rate is required, which is important in view of seed scarcity and cost.
- Better establishment than by broadcasting in case of poor weather conditions.
- Easy weeding and fertilizer application.
- Better exposure of plants to sunlight.

Common establishing methods of establishing forage plants are:

- Direct seeding (Broadcasting, Spot seeding, Row seeding)
- Seedlings
- Cutting &Splits

The choice for these methods of establishment is determined by plant species, planting material availability and environmental conditions.

Generally, the following guide can be used:

- Tree legumes: seedlings, cuttings, and direct seeding
- Herbaceous legumes: Direct seeding
- Grasses: Direct seeding, cuttings, and splits

Self-Check – 8	Written test

Name…… ID…… Date…….

Directions:

Part I. Answer all the questions listed below.

1. Mention the advantages of row sowing method over the others (3pts)

Part II. fill in the blank spaces/

2. The choice for these methods of establishment is determined by _____, _____ and _____conditions.(3pts**)**

Part III. Choose the best answer

3. which one of the following is not important for sowing practice (2pts)

A. Spacing B. timing C. sowing depth D None

Note: **Satisfactory rating – 6 points Unsatisfactory - below 6 points**

You can ask you teacher for the copy of the correct answers.

Information sheet 9- Applying fertilizers

Fertilizing and manure application

For grass-seed crops, nitrogen is the most limiting soil nutrient. Generous amounts of nitrogen, often in combination with phosphorus, substantially increase seed yield of grasses (100–150 kg/ha ammonium phosphate). Nitrogen application varies with soil fertility, moisture level and the type of species sown. Legume seed crops are independent of soil N levels as long as they effectively fix atmospheric nitrogen.

Improved pastures require fertile soils for optimal herbage production. Basal applications of the macronutrients, especially nitrogen (100–150 kg/ha urea) and phosphorus (50 kg/ha triple superphosphate) are helpful for successful establishment. However, considering the economic status of farmers, use of farmyard manure, as much as possible, is advisable at the rate of 5–10 tons/ha (t/ha).

If the pasture to be established contains a good proportion of adapted and readily nodulating legumes, the nitrogen application may be ignored or reduced to a starter dose (10–25 kg urea/ha) in anticipation of atmospheric nitrogen fixation after some weeks by the legume component.

Fertilizers should be applied according to the fertility status of the soil. To determine what nutrients are needed:

- Observe characteristic symptoms, e.g., leaf yellowing is likely a nitrogen deficiency.
- Undertake soil and plant tissue analysis.
- Know the characteristics of the plant, e.g., tall and rank-growing grasses such as elephant grass and *Panicum* species are heavy feeders and require more frequent fertilizer applications than thinner and shorter stature grasses.

Generally,

- Legumes have a high requirement for phosphorus (P), sulphur (S) and Molybdenum (Mo);
- Grasses have a high requirement for nitrogen (N), P, and Potassium (K).

Levels of nutrients used will depend on soil type, species used, level of production required, and production system (cut-and-carry systems require greater maintenance inputs than grazing systems). Typical levels of nutrients required for annual maintenance are 50–300 kg/ha N; 10–20 kg/ha P; 25–50 kg/ha K; 30 kg/ha S; and 100–200 kg/ha Mo. Nitrogen is often applied at each grazing or cutting. Phosphorus should also be applied especially if the legume component loses vigor due to grass dominance. Manipulating the ratio of application of nitrogen and phosphorus is a useful management technique to maintain a desirable balance between the grass and legume components.

Nitrogen fertilization increased yield, rate of growth and improved CP content during the earlier part of growth. Additionally, DMY and sward quality can be increased through means of fertilizer application, resulting in an abundant feed stuff. After fertilizer N is applied, N is rapidly absorbed in to plants and growth, while stimulated via improvement of root systems and photosynthetic activity.

The mineral composition of range plants depends upon various environmental factors such as geographic aspects, climate, soil minerals, grazing stress, seasonal changes and the ability of plant to get minerals from soil. Application of inorganic fertilizer can significantly improve the productivity and quality of grass lands. CP values lower than 8% are considered to be of inferior quality. Leaf CP content decreased as the leaf aged, but increased as the rate of nitrogen fertilizer increased.

Nitrogen plays an important role in plant growth and physiological processes, as it enters all enzymes composition and enhances vegetative growth and yield. Nitrogen is a constituent of the proteins that participate actively in the synthesis of the organic compounds that comprise the vegetative structure, and it is responsible for size related characteristics of the plants such as plant height, size of leaves and stem, and shoots emergence and development. Experiments conducted with fertilizers have shown that N application increases dry matter production, the maximum amount of N to be applied depending upon the grass species and type of management. The dry matter yield of the grass component increased as the level of nitrogen fertilizer increased.

Self-Check – 9	Written test

Name…… ID…… Date…….

Directions:

Part I. Answer all the questions listed below.

1. Mention the factors that affect the mineral composition of range plants .(5pts)

Part II. fill in the blank spaces/

1. Legumes have a high requirement for _____, _____ and _____ nutrients/minerals.(3pts**)**

2. Grasses have a high requirement for _____, _____ and _____ nutrients/minerals.(3pts**)**

Part III. Choose the best answer

1. To determine what nutrients are needed in the soil which one is correct(2pts)

A. Observe characteristic symptoms, e.g., leaf yellowing is likely a nitrogen deficiency.

B. Undertake soil and plant tissue analysis.

C. Know the characteristics of the plant

D. All

Note: **Satisfactory rating – 6 points** **Unsatisfactory - below 6 points**

You can ask you teacher for the copy of the correct answers.

Information sheet 10. Selecting machinery and equipment

10.1. Selecting and checking machineries and equipments

Agricultural machinery and equipment is tangible personal property that is used directly in cultivating or harvesting a crop, collecting or processing of an agricultural product on the farm area.

What may be involved in routine pre-operational checks of machinery or equipments?

This may include routine safety and pre-start checks and preparatory procedures including cleaning, lubricating, and hand sharpening, priming pumps, clearing filters, tightening, basic repairs and adjustments.

10.2. Pre-operational checks:

On machinery and equipment may include checking of the following parts for their function

- **Fuels, fuel lines and oils*:*** check the oil and the fuel line if it is not in good condition change or fill the oil and fuel respectively.
- **Battery electrolyte levels, wheels and tires pressure**: when servicing the battery or checking the electrolyte level, wear rubber gloves, a rubber apron, and eye protection. Batteries contain sulfuric acid which is destructive. If it comes in contact with your skin, wash it off at once with water. Acid may splash on the skin or into the eyes inadvertently when removing electrolyte caps.
- **Air filters*:*** check the air filter if there is impurities on it, clean it with appropriate materials like air compressors.
- **Safety guards*:*** check the safety guards are located in the appropriate position

1. Operating a tractor

Tractors are the main cause of accidental deaths on farms. Over the years, many farmers, farm workers and others living on or visiting farms, have been killed or seriously injured falling from moving tractors, being run over by tractors, or being crushed when a tractor rolls side-ways or backwards.

- **The hazard**

Regularly check for hazards relating to tractors, attached implements and field conditions. Hazard areas could include mechanical parts, operator training, other people, work procedures, unsafe jacking, climatic conditions, chemicals used, uneven terrain, and any other potential causes of an injury or a hazardous incident. Keep a record to ensure identified hazards are assessed and controlled.

- **Assess the risk**

Once a potential hazard has been identified, assess the likelihood of an injury or hazardous incident occurring. for example, risk to children playing near a tractor will vary, depending on what the tractor operator is doing, how close they are to the tractor and whether the operator knows they are there. Consider ways of minimizing risk.

- **Make the changes**

Read and follow safety procedures in the manufacturer's manual....

1. tillage equipment

While the skilled operator of tillage equipment avoids errors with very little conscious thought, accident studies show that hurrying and human error are responsible for or are involved in the vast majority of equipment accidents. An operator must have an understanding of the function, operation and limitations of the equipment he/she is operating and the operator must resist the temptation to be hurried into an accident

Key points and supporting information

- **Moldboard plows**
- **Disk Plows**.
- **Disk Tillers or One ways**

  Select and keep it clean and prominently displayed. Do the same with reflectors and warning lights as required by state and local regulations.

- **Disk Harrows and Offset Disks**

Always lock safety lock during transport, if the disk is to be left raised for an extended period, or while working on the machine.

10.3. Field Cultivators

- Never exceed recommended transport speed for the cultivator used. If speed is not stated, do not exceed maximum tractor speed.
- Reduce speed for turning and travel over rough or uneven ground.
- Use transport locks and relieve pressure in cylinders when transporting field cultivators. Do not depend on hydraulic pressure to carry the weight. Always lock wings in transport position and relieve pressure in cylinders.
- Never walk or work under wings when they are in the folded position.
- Follow state and local regulations regarding lights, reflectors, SMV emblem, and maximum width when transporting on roads or highways.
- Transport width of most field cultivators exceeds normal vehicle width. Therefore, use extreme caution when meeting other vehicles and avoid the possibility of dropping tractor or-implement wheels into holes, drains, or ditches along the road edge.
- Never permit anyone to ride on the tractor drawbar or cultivator in transport or operation, or to stand near the machine while it is operating--particularly when raising or lowering wings.

Self-Check – 10	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

1. Mention the precaution to be taken during conducting cultivating by field Cultivators (5pts)

2. Mention reasons of pre operational checks of machinery (2pts)

Note: **Satisfactory rating - 7 points** **Unsatisfactory - below 7 points**

You can ask you teacher for the copy of the correct answers.

LG # 35	LO3. Manage and preserve forage production

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics –

- Determining livestock feeding methods and identifying feed problems.
- Using livestock to control stubble and fallow weeds
- Growing grazing program.
- Controlling and managing grazing
- Managing grazing.
- Determining forage and pasture preservation methods.
- Documenting data

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, **you will be able to –**

- Determine livestock feeding methods and identifying feed problems.
- Use livestock to control stubble and fallow weeds
- Grow grazing program.
- Control and manage grazing
- Manage grazing.
- Determine forage and pasture preservation methods
- Document data

Learning Instructions:

11. Read the specific objectives of this Learning Guide.
12. Follow the instructions described below.
13. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
14. Accomplish the “Self-checks” which are placed following all information sheets.

15. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
16. If you earned a satisfactory evaluation proceed to “Operation sheets
17. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
18. If your performance is satisfactory procee
19. d to the next learning guide,
20. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information sheet 1- Determining livestock feeding methods and identifying feed problems

1.1. Introduction

Supplementary feeding at important stage aims to make better use of this feed by supplying those nutrients that the pasture is deficient in, so that animals can be cheaply maintained while decisions are being made. Supplementary feeding is an option only when there is paddock feed available. When availability of paddock feed becomes limited, survival feeding or production feeding must be implemented.

'Survival feeding' means providing an animal with the minimum feed it needs to stay alive; 'Production feeding' means, for adult stock, sufficient food for successful breeding or, for younger animals, sufficient food to meet growth and/or market targets.

1.2. Supplementary feeding principles/methods

To be effective, the supplement you choose must make up for the main nutrient deficiencies in the paddock feed. Dry feed is often deficient in protein and sulphur. In cases where the feed is green but very short, it is the low energy intake which limits production.

The following principles for efficient use of supplements should be followed.

- Identify the most limiting components, usually protein, sulphur and/or metabolisable energy.
- Select supplements containing high levels of the identified limiting components.
- Balance the supplement to ensure efficient rumen function
- Young and lactating animals have a greater need for protein.
- Choose feeding techniques which minimise disruption to the animals' digestive system.
- Cost out the program, taking into account alternative measures.
- Start feeding those animals with the greatest needs, for example pregnant cows of low fat score, or weaners below critical live weights.
- Monitor feed consumption, live weight and condition; so that you can confirm that your strategy is working.

1.3. Concentrates

Concentrates are nutrient-rich feeds – they provide far more nutrients (energy and/or protein) than an equivalent amount of bulk forage. They include compound feeds manufactured by milling companies, such as dairy meals, cubes and pellets, as well as single ingredients, such as brewers' waste, maize germ meal or molasses.

Concentrates differ from supplementary forages in two main ways: they usually have little or no fibre and also usually have a higher dry matter content.

1.3.1. Advantages of concentrates:

- Supply concentrated nutrients.
- Contain very little fibre.
- Have high dry matter content.
- Are palatable (cattle like to eat them) and easy to digest

1.3.2. Disadvantages of concentrates:

- Are expensive.
- Quickly break down in the rumen forming acid which can prevent effective digestion of forages.
- Can cause health problem if too much is eaten, for example where concentrates form 60 to 70 per cent (dry matter) of a ration or more than 14 kilograms is fed per day

1.3.3. Economics of feeding concentrates

Failure to feed enough supplements, especially early in the lactation, is the main reason why many cows give much less milk than they are capable of, which reduces the profit the farmer could have made. Also, soon after calving cows cannot eat enough bulk to provide all the nutrients they need and supplements, including concentrates, are especially needed at this time.

As much forage as possible should be fed before supplementing the ration with concentrates. Too little forage in the ration can also lead to a decrease in milk fat content. Concentrates are expensive – more expensive than forages - and they should therefore be used to support additional milk production. This means that the farmer will get a return on the money spent

on concentrates. If the rules of concentrate feeding are followed (see below), money spent on concentrates will lead to higher milk yields and higher profits.

1.3.4. How to feed concentrates

The type and amount of concentrate to feed an individual cow will depend on the quality of forage the cow is given and the level of milk production. Forages vary in quality: generally legumes are of high quality, fresh grasses medium and crop residues, such as straw, low quality, containing high, medium and low levels of protein, respectively.

If the milking cow is fed on forage with a low protein content, such as tall, overgrown Napier grass or dry maize stalks, then concentrates with a high protein content need to be given to provide a balanced diet and support a high milk yield. If the cow is fed on high protein forages, such as good quality pasture, or also receives supplementary forages, such as lucerne, lower protein concentrates can be used – or no concentrates may be needed, depending on the cows' milk yield.

1.3.5. How much to feed?

Concentrates are expensive and therefore should be fed carefully to get the best return on your investment. The amount of concentrates fed should depend on the level of milk production and the quality of forage. The most economical level of feeding concentrates is the point at which the last amount of additional concentrate added to the ration is just paid for by the extra milk produced by that unit of concentrate. But this point may be difficult to determine for individual cows

- it requires careful measurement of the amount of concentrate given and milk produced. Also, it is influenced by changes in milk and feed prices
- if the milk price drops, it may no longer be economical to feed as much concentrates.

1.4. Challenge feeding*:*

This method of concentrate feeding is traditionally recommended for cows in early lactation. Begin with a low level of concentrates, such as four kilograms of dairy meal per day, and gradually increase the amount of concentrates fed each day until the point is reached when

adding more concentrate does not result in an increase in the next day's milk production. Continue with this level of feeding for the first 12 weeks of the lactation. After 12 weeks, the amount of concentrates fed should depend on the milk yield. If the cow is fed on good quality forage it should be able to produce five to ten litres of milk per day on forage alone. For every litre of milk produced over and above five litres, feed half to one kilogram of concentrate. So, for a cow producing eight litres of milk per day after 12 weeks, feed one to two kilograms of concentrate per day.

1.5. Soiling or zero grazing*:*

This is the feeding of cut crops to housed stocks. Bringing forage to animals has the advantages that animals can be tightly controlled by restricting their movement, farmers can determine what the animals are offered to eat, manure can be collected easily, and the animals have less contact with certain biting flies and ticks.

Advantage:

- Efficient herbage utilization
- No loss due to trampling
- Uniform herbage intake
- Control bloat through wilting

Disadvantage:

- High cost for labor or machinery
- Bedding required for housed stock
- Manure disposal is laborious

1.6. Water

All animals need water for their bodies to function normally. Without water animals die quickly, within a day or two– much more quickly than they would without food. Water is needed to make saliva to enable feed to be swallowed and for chewing the cud, for food to be digested, to cool the body when it is too hot and to remove waste materials from the body in the urine and faeces. In addition a milking cow needs water for milk production: it takes about five litres of water to produce each litre of milk.

Cross-bred dairy cattle are not well adapted to heat stress and it is therefore especially important to make sure that water is available to them at all times. The amount of water a dairy animal drinks per day depends on many factors, including how much milk is produced, how hot it is, the amount of feed eaten and the water content of that feed.

Self-Check – 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

3. Mention the advantage and dis advantages of zero grazing or cut and carry system (5pts)

4. Mention the challenges of concentrate feeding (2pts)

Note: **Satisfactory rating - 7 points** **Unsatisfactory - below 7 points**

You can ask you teacher for the copy of the correct answers.

Information sheet 2. Using livestock to control stubble and fallow weeds

2.1. Grazing animals as Weeds Control agents

Fallow weeds are those weeds which are uncultivated/ unsown herbaceous or woody feeds grow in the pasture land

Literature on the effectiveness of grazing animals (especially cattle, goats, and sheep) in controlling weeds is reviewed. Availability of animals and the ability to fence them onto or off weed infestations are essential. Weeds of pastures are the most suitable subjects for control, although weeds of arable crops, forestry, and waste places are sometimes amenable to control by grazing animals. Although grazing animals themselves often cause weed problems in pasture, adjusting grazing timing or intensity or both can sometimes redress the balance. Increasing sheep or cattle stocking rates prevents animals from grazing selectively and can help control some weeds. Adjusting grazing pressure can also improve the growth of desirable pasture species so that these are more competitive and able to resist invasion of annual or biennial weeds. Introducing a different class of stock, like sheep into a cattle system or goats into a sheep system can control many weeds. Goats are capable of browsing on and controlling spiny or poisonous brush weeds, including gorse and poison ivy, without suffering adverse effects. Examples are given of the use of grazing animals for weed control in crops and forestry

Especially when grazing animals are being used for weed control, there is a significant opportunity for using a careful combination of animals, conventional bio control agents, herbicides and cultural control.

This weeds can be controlled using different methods depending on farmer's choice and resources available. The following methods are commonly used:

- **Manual method-** This involves identifying weeds in pastures and physically removing them by hand pulling. They can be gathered in one place, burnt and buried.
- **Chemical method**- Weeds can be controlled using chemical means such as herbicides. However, there are some negative implications to the environment and farmers.

- **Cultural method-** This involves weeds control using biological means such as grazing livestock or other species that can eliminate the weeds through competition etc.

In a grazing land, when weeds invade the pasture land one of the cheapest method is use of proper grazing system.

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2.2. Plant residue and pest control

Integrated weed management (IWM) has not been adapted widely or as readily as integrated pest management (IMP), now widely accepted as a way of dealing with insect pest of plant in some situation. IPM often a combination of Biological, Cultural, and insecticide control ,coor-dinated so that beneficial insects are not adversely affected by pesticide.in the case of weeds chemical control, cultural control and biological control tend to be studied and often applied independently.

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Self-Check – 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

1. Mention how grazing management can be a remedy for pest control mechanism(3pts)
   _____
   _____
   _____
2. mention the different types of weed control (3pts)

Note: **Satisfactory rating - 6points** **Unsatisfactory - below 6 points**

You can ask you teacher for the copy of the correct answers.

Information sheet 3- Growing grazing program

Grazing system

This refers to manner in which grazing and non-grazing periods are arranged within the maximum feasible grazing season, either within or between years. The grazing system selected must be adapted to the forage plant species being grazed, the grazing season, the physiographic of the grazing land, the nutritional needs of the kind and class of livestock to graze, and the management objectives.

Objective of proper grazing system are:

- to maintain a favorable balance between herbage species
- to maintain high production of good quality forage for the longest possible period
- to achieve efficient utilization of the forage produced
- to achieve high animal production

For a grazing system to be effective and practical, the following characteristics are commonly suggested.

1. it is based on and suited to the physiological requirements and life history of the primary forage plant
2. it will improve vegetation low in vigor or maintain vegetation already in high condition
3. it is adapted to existing soil condition so erosion and pudding will not result from livestock trampling
4. it will favor the desirable plants and promote high forage productivity
5. it is practical to implement and reasonably simple to operate

Utilization of pasture is one of the most important aspects of pasture land management. For proper utilization the entire area should be divided in to number of blocks based on its carrying capacity and rotational grazing system should be applied. In this system of grazing, the sequence of grazing is changed in the way that each block is grazed for specific period and protected for the rest.

There are different systems of grazing like controlled, continuous, deferred, rotational, periodic grazing and etc. each of these has its merits and demerits. However, control of the number of animals grazing under any system is of prime importance.

Self-Check – 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

3. Mention at least three common characteristics grazing system to be effective and practical (3pts)

   _____
   _____
   _____

4. The grazing system selected must be adapted to:
   - _____
   - _____
   - _____
   - _____ and
   - _____. (5pts)

Note: **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

You can ask you teacher for the copy of the correct answers.

Information sheet 4 Controlling and managing grazing of forage and pasture

4.1. Introduction

A well-managed pasture is one whose productivity (plant and animal) is optimized while it does no harm to soil, water, and air quality. Pasture condition scoring is a systematic way to check how well a pasture is managed. If the pasture is located on the proper site and well managed, it will have a good to excellent overall pasture condition score. By rating key indicators and causative factors common to all pastures, pasture condition can be evaluated and the primary reasons for a low condition score identified. A condition that can lead to one or more pasture resource concerns such as poor plant growth, weedy species invasion, poor animal performance, visible soil loss, increased runoff, and impaired water quality.

Pasture condition scoring, to be most useful, should occur several times a year during key critical management periods throughout the grazing season. Scoring should be performed:

- At the start before placing livestock on pasture
- At peak forage supply periods
- At low forage supply periods
- As plant stress appears
- Near the end to help decide when to remove livestock

Controlled grazing combines the principles of forage, livestock and management to meet a farm's goal. Understanding forages growth to get optimum forage quality and quantity of production is the step in capturing the solar energy. The next step in producing a merchandisable product is to have livestock harvest this forage at the stage that will best benefit both the animal and the forage plants. Management, or how to put together the number and size of paddocks plus other considerations, is the final principle of controlled grazing, it is the complicated interaction of three biological units human. Animal and plants. Putting them together to meet your goals is a lot like riding a bike.

4.2. Pasture management practices

Pasture management is the science or art of securing maximum sustained use of improved grazing land, forage crops with animal grazing without being detrimental or without any serious damage to the resources or use of the land.

Grazing management is the manipulation of grazing animals to accomplish desired results in terms of animal, plant or economic response. The main aim of grazing management practices are.

1. To provide a supply of nutritious herbage over the growing season at low cost
2. To avoid physical waste of herbage and inefficient utilization by the animal
3. To maintain the productive capacity of the sward.

Grazing management should: balance livestock demand with forage availability, promote rapid pasture regrowth during the grazing season and promote long-term pasture persistence. The art of grazing management is to ensure that there is sufficient pasture in a stage suitable to graze at all times throughout the grazing season. Several grazing management systems define different methods of harvesting the forage. Therefore, knowing the decisive factors of stoking rate per a given pasture is important.
Grazing system in practices are as follows:

4.2.1. Continuous grazing

This grazing type is an extensive system of grazing in which the stock remains on the same pasture area for prolonged periods. Continuous grazing has often been criticized as detrimental to the vegetation. However; the cause of deterioration commonly has been due to rather heavy grazing and poor distribution of grazing. If number of animals allowed to graze is higher than the carrying capacity of grassland, there is fast depletion of desirable species and deterioration of grassland in due course of time.

4.2.2. Rotational grazing: is an intensive system of grassland management practiced on improved permanent or lay pasture. Rotation grazing is a generic term applied to moving grazing animals recurrently from one grazing unit (paddock) to another grazing unit in the same rotation series (group); in this regards, it is the opposite of continuous grazing.

In this type of grazing method the grazing area is subdivided into a number of paddocks, usually at least six, and the animals are moved systematically from one to another of these in rotation. Each paddock is grazed for a period of 3 to 7 days, the length of the grazing period depending on stocking rate and herbage growth rate.

Rotational grazing involves fencing a pasture into several small paddocks. Subdivision is a useful way to balance livestock needs with forage supply. Livestock graze the paddocks in sequence, moving to a new paddock when the forage is ready for grazing. In general, put livestock into a paddock when the forage is 25–30 cm tall; remove livestock when the pasture is grazed down to 8 cm. A relatively high stocking rate for the size of the paddock forces the animals to be less selective in their grazing and to graze the paddock off evenly. The animals are removed before they start to graze new plant growth and the paddocks are rested.

Dividing the fields allows some of the paddocks to be harvested for hay early in the season. This hay can be fed back if and when the pastures do not produce enough forage for the livestock. When planning the area to be cut, consider how much will be needed to support the livestock until the hay aftermath is ready to be grazed. The later the first cut, the slower the regrowth. This delays putting the cut area back into pasture rotation and puts extra pressure on the grazed area.

There are three major advantages of rotation grazing over continuous grazing on improved pasture are

i. improved plant persistence,
ii. Opportunities to conserve (mechanically harvest) surplus forage, and
iii. More timely thus more efficient utilization of forage.

With rotation grazing, excess forage can be harvested as hay or silage for feeding during periods of low forage production; losses due to herbage trampling, fouling, and senescence are reduced by more timely utilization. On the other hand, continuous grazing has the advantage of lower input costs such as fencing and water facilities; also, management decisions

are simplified because livestock are not being managed using high density and restricted area which require frequent moves from grazing unit to grazing unit.

4.3. Designing a Rotational Gazing System

To design a rotational grazing system, inventory the:

- State of your pastures
- Layout of current fences
- Location of watering and handling facilities.

To keep costs reasonable, incorporate the existing fencing into the scheme. All paddocks must have access to water and the layout must accommodate this.

The number of paddocks required is based on the length of time it takes for the pasture to recover after being grazed. This is essential for keeping the pastures productive.

4.3.1. Length of Rest Period

The number of days required for rest differs over the grazing season. The required rest period fluctuates not only within the season but also from year to year. A good rotational system must be flexible to handle these changes.

4.3.2. Days of Grazing per Paddock

The time the animals spend in a paddock must be long enough to graze the pasture off evenly but short enough to prevent grazing of new regrowth. The faster the animals are in and out of a pasture the better in terms of forage production. This is to prevent the next field from becoming too mature and being largely wasted by the animals.

4.3.3. Paddock Shape

Paddocks work best if they are square, rather than rectangular or irregularly shaped. Long, thin paddocks tend to encourage livestock to graze at the end nearest water, minerals or shade, and to avoid grazing the distant end. Square corners are easier to hay or clip. Design your paddocks to allow access to machinery for carrying out these operations as well as fertilizing.

4.4. Deferred grazing is the setting aside of certain pasture paddock for use at later stage e.g. Standing hay

Deferment, early season non grazing |delayed grazing| and rest treatment are based on providing non grazing within the feasible grazing season during periods that are expected to enhance the forage stand.

Deferment provides for non-grazing from the breaking of dormancy until after seed set or equivalent vegetative reproduction is meaningful only when applied to perennial forage plant species and is best adapted to areas where both growth and grazing are seasonal. Forage quality is seldom directly enhanced by deferment from grazing, although it may be indirectly enhanced if deferment induces a desirable qualitative change in species composition over time. However, in order to maximize nutritive value of the forage consumed, deferment should not be applied to improved, intensively management pasture. Deferment is generally unnecessary to maintain vigor in improved pastures, shortens the green growth period, and reduces nutritive quality by advancing forage maturity.

The objective of deferment are to increase seed production, enhance seedling establishment , protect plants susceptible to trampling damage and defoliation in early spring and to prevent overgrazing during low forage availability during early spring.

Advantage:

- plants vigor is built up
- enables self –regeneration from fallen seed

4.5. Forward Grazing

This is a variation of rotational grazing where the pasture is grazed by 2 groups of animals. The first groups into a paddock are those with the higher nutritional needs. They graze the tops of the plants which is the most nutritional part and are not forced to graze forage of lower quality. The second group, with lower nutrient requirements, grazes the forage left by the first group. This system works well where milking cows are the first to graze a paddock, with dry cows or heifers used to clean up the pasture. Young animals are allowed access to pastures ahead of their dams.

4.6. Mixed Grazing

This approach to grazing management takes advantage of the fact that different types of livestock like to graze different plants. Two or more types of animals graze the paddock at the same time or follow one another through the paddocks. Sheep and cattle make a good combination. Do not graze sheep with horses.

Self-Check - 4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

5. Mention the advantage and dis advantages of zero grazing or cut and carry system (5pts)

6. Mention the challenges of concentrate feeding (2pts)

Note: **Satisfactory rating - 7 points** **Unsatisfactory - below 7 points**

You can ask you teacher for the copy of the correct answers.

Information sheet 5 – grazing management

5.1. Grazing management

Grazing management is the planning, implementation and monitoring of animal grazing to achieve sustained animal, plant, and land, environmental and economic results under a range of environmental conditions.

Grazing management practices seek to optimize livestock production and maintain productive grasslands by minimizing overgrazing, improving forage production and increasing plant and animal diversity. Grazing, when well-managed, allows healthy grasslands to be sustained, livestock operations to meet economic requirements and other plants and animals to flourish. Well-managed grazing techniques can reverse damage and help to restore grassland health.R

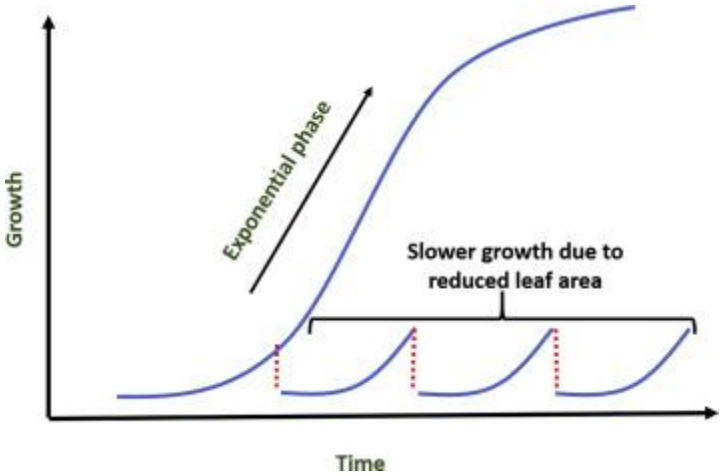
Please refer LO2, Information sheet 3 for different types grazing management above

5.2. Grazing management strategies

Grazing management strategies include the adjustment of stocking rate, stocking method, and whatever other method is available to manage defoliation. Grazing frequency, intensity, and timing are the major aspects of defoliation affecting plant regrowth. Maximizing plant growth, forage quality, and harvesting the forage efficiently with grazing animals are the ultimate goals of the grazing manager. It is also important to reach economic goals and to apply sustainable management practices. Sometimes greater plant or animal productivity may not be the best option to maximize economic and environmental benefits.

Rotational stocking often results in greater herbage accumulation, because these plant canopies have greater leaf percentage and younger average leafage than those in continuously

stocked pastures. As a result, forage in rotationally stocked pastures spend a greater proportion of time in the linear phase of the forage growth curve (Fig. 3). Greater nutrient use efficiency is the result of more products and services being delivered per nutrient unit. However, it is important to optimize both herbage accumulation and forage nutritive value. This is a challenging task since forages often increase herbage accumulation with longer rest periods between grazing events, but forage nutritive value declines as plants mature.



Self-Check - 5	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

7. what is grazing management (2pts)

8. what is the difference between grazing management and grazing management strategy (2pts)

Note: **Satisfactory rating - 4 points** **Unsatisfactory - below 4 points**

You can ask you teacher for the copy of the correct answers.

Information sheet 6 Determining forage and pasture preservation methods.

6.1. Preservation

Losses up to 30% DM in the silage may happen. Losses of nutrients can be even higher (DCP up to 60-70%) due to refusal, soil contamination, side losses in the pit and risk of quality. In hay making there are losses due to weather conditions, leaf losses, storage and refusal.

6.1.1. Legumes

The feeding value of legumes (lucerne, alfa alfa, clovers) varies less when compared to grasses. Protein and mineral contents are often higher, whereas the CF content is lower compared with grasses. Legumes have a high calcium, but a low phosphorus content. Legumes can be conserved as hay, but leaf losses may be very high. They are less suitable for silage making. The inclusion of some fresh legumes in a diet can be very beneficial for a high yielding dairy cow.

6.1.2. Fodder Crops

The most common fodder crops are: roots, beets, carrots, cassava, turnips, swedes, mangolds, tubers (sweet potatoes + vines, potatoes), fodder grains (maize, sorghum, oats, rye) and Brassica species (kale, cabbages, rape). The main advantage of these fodder crops is, that they are capable of producing high yields per/ha, often during periods when other roughage (grass) are in short supply. Frequently they are produced on irrigated land and can be fed fresh or conserved (maize silage), while some products can be relatively easy stored (tubers, roots).

6.1.3. Fresh/green fodder crops provide a welcome component in a diet, especially where dried roughage and concentrates are prevailing. Care should be taken with the laxative effect these fodder crops generally have, which may cause diarrhoea (introduce gradually) and may depress the fiber digestibility of other components of the ration.

6.1.4. Fodder grains can give high yields: relatively energy rich roughage per unit land. The feeding value depends largely on the quantity and maturity of the seeds included. Sometimes, seeds are harvested for human consumption. This reduces the feeding value of the remaining

plant. The protein content is relatively low. Maize is an excellent product for silage making, sorghum can provide several cuts of fresh material (irrigation and cutting at immature stage).

6.1.5. Sorghum should not be grazed during the first 3-4 weeks after cutting. Sorghum may contain a rather high amount of prussic-acid in the young stage, causing poisoning (death).

6.2. Conserved Roughage

Roughage can be conserved into hay or silage. Losses during the conservation process and storage can be 30-50% of the DM, due to continued respiration, leaching by rain, mechanical handling and self-heating. The losses depend on the climate and the success and speed of the conservation process. Generally, losses of energy and DCP are even higher, up to 75%, leaving a conserved product with a low quality compared to the original product. Before fodder conservation is practised, the real feasibility of conservation should be determined, as well as the extra costs for equipment. Modern conservation methods (wilting, quick harvesting and proper sealing) can reduce losses in silage making considerably (15-20% DM).

6.2.1. Hay making

Hay is defined as green forage dried &stored at about 85% DM content from the technical point of green plants so that they can be stored safely without undergoing any change interims of quality &nutritive value

I. Crops suitable for hay making

Forage crops having **soft and thin stems** are generally believed to be more suitable for hay making. Green oat is said to be the excellent .one cow pea, alibi and lablab are best for hay making from among the legumes

Grass species like Bermuda and buffle grass are also among the most suitable for hay making. Fodder crops like maize and sorghum are more suitable for silage than for hay making

II. Stage of harvesting the crops for hay making

The feeding value of crops decline or drop shapely with advancement in age of crop

At early stages of the crop:

- The protein, vitamin, & energy contents of the forage crop are very high
- Water content and digestibility of different nutrients are also higher
- But the dry matter yield of the crop per unit area is considerably low

At the later stages of the crop

- The value of different crop officers the protein value of the crop will decrease sharply
- But the dry matter yield per unit area will increase to a large extent
- The forage crops for hay making must be harvested just at about their early flowering stage this is the time when about 10-20% of the crop is at its full bloom

III. Curing /drying /of hay

In curing hay the main objective is to remove moisture sufficiently and to preserve maximum nutrients to prevent moldiness and spoilage during storage. Curing is done either is the filed or under a shad in a barn. But practical curing in filed

Characteristics of good quality hay

- Good quality hay should be green and leafy
- Look in to the hay, if it is more of leafy and green in colour
- Leaves are parts are richer in carotene, protein, mineral and nutritive value in general
- should be soft and pliable with less amount of moisture
- Take the stem of the hay plant and scratch its epidermis or top layers, if it can be peeled of these this show that the hay is not properly cured
- should have the characteristics aroma and smell of the crop from which it is prepared

Precaution in hay making

- Crops should be cut at the right stage of maturity during sunny days
- Shattering and loss of leaves should be restricted to minimum
- should not be stacked on damp temperature

Figure 2. Good quality hay

6.2.2. Silage Making

Silages: is a feed produced out of controlled acid fermentation of green forage crops

ensiling :-is the name given to the process of silage making it consists the technique of pre-serving freshly cut forage crops in an air tight silo the comical process that take place in the ensiling process have two phases:

i. Phase-I=Aerobic Respiration

- After ensilaging the forage crops, the living plant cells continue to respire for some time they consume the O_2 present in the silo and give off CO_2 and H_2O with the production of heat this causes rise is temperature inside the silo. This condition paves the growth of aerobic micro organism
- After aerobic respiration is completed, microbial changes slit

ii. Phase –II-Anaerobic Respiration

This anaerobic condition favours the growth of acid forming anaerobic bacteria &their multi-plication. The chemical reaction that take place in this condition include:

- Conversion of sugar in to lactic acid followed by other volatile acids such as formic acid acetic acid, propionic & butyric acid
- Breaking down of portion in the feed in to amino acid, amines, ammonia
- The formation of all this acid will lower the P^H inside the silo to as low as 4 to 3.5. bacterial fermentation thus ceases at this very low P^H

Silo: - is the air tight structure or container where silage is prepared there are d/t types of silo. They can be classified as tower silos, pit silos, trench silos.

iii. Kinds of silos

I. **Tower silo**

Tower silo is an upright structure generally circular in shape and equipped with a number of doors at different height the doors are normally closed when the silo is filled and opened at the time of silage removal alone

II. Pit silos

- Pit silos are constricted by digging a pit in to the ground
- The shape of this type of silos could be squire, rectangular or circular

- These types of silos are very much suitable for place where the water table is very low. Otherwise, the silos could be filled by water from the under ground

Pit silos have advantage over tower silos in that they do not require reinforcement

III. Trench silo

Theses silos are constructed especially on gentle slopes completely below the ground level they are suitable

- For areas with good damage they can be either of cemented or earthen walls
- Trench silos are better to conserve large amount of silage and they require only very low cost for handling
- Maximum compression of silos during filling is possible using factors

IV. Bunker silos

Bunker silos are constricted above the ground level usually with concrete floors they need very high cost for construction as compared to pit and trench silos. Recently there is a use of temporarily silos like plastic bags and tin cans or any air tight material

iv. Characteristics of good silos

- good silos should always be air tight
- the corners of the silo should be rounded to allow better compaction during packing
- good silos must have good drainage
- they must have enough spaces and be durable for repeated use

v. Stage of harvesting crops

Stage at which crops are harvested for silage making has a profound effect on the quality of silage crops at the appropriate stage the approximate stage for good quality silage making is given below

- Most grass species ⇒ after the heads have emerged
- Oat and maize ⇒ at mid or early dough stage
- Alfalfa ⇒ early to 50% flowering
- Cow pea ⇒ soon after the first pods have filled seed

Advantages of silage making

- Where the production of high quality hay is not possible due to weather conditions.

- Silage saves feed that would be inedible in the dry state or would be damaged by rains
- It is quite palatable and has a high content of carotene.
- It clears the ground early and completely for another crop.
- Storing a crop as silage instead of hay

Limitations of silage making

- It requires additional outlay for structures, equipment and power.
- It concentrates the labor of harvesting into a few days since the silo has to be filled quickly (in 1–3 days).
- Most silage has a low content of minerals and protein and is not suitable for use as the sole ration.
- If it is fed in place of legume hay in the ration, more expense must be incurred for high-protein feed.

Figure 3. Silage making steps and how to make silage.

Self-Check -6	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page

1. explain the two phases of respiration in the process of silage making? (2pts)
2. List methods of utilization of developed forage (4 points)
3. What are the disadvantages of cut and carry system? (3 point)
4. Mention the characteristics of good quality hay (3 points.)

Note: Satisfactory rating – 10 points unsatisfactory rating –below 10 points
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Information sheet 7- Documenting data

7.1. Documenting data for continual assessment and planning management

What to measure and when

- regularly check pasture growth and livestock stock class performance and assess against targets set in the grazing plan
- use a rate of pasture assessment techniques
- Aim to balance the level of animal intake (i.e. head/ha* intake /head should be equivalent to pasture growth /ha) in relation to predicted pasture growth rate to get the best pasture e utilization in targeted and longer grazing events.
- review and revise fortnightly or weekly, according to the need of stock class and pasture management

The longer the grazing period, the more critical monitoring becomes as other control, such as grazing duration and manipulation of graized area with temporary fencing decline with effectiveness.

Planning data includes:

- area to be grazed (ha)
- target graze period for the paddocks (days)
- daily pasture growth estimates
- initial pasture herbage mass(kg DM/ha)
- initial pasture quality (MJME/kg DM. or simply M/D)
- predicted pasture growth for the grazed period for the zero period (kg DM/ha/day)

7.2. Monitoring data

Includes:

- **Pasture assessment**
  - ✓ assess pasture mass in paddocks(kg green DM/ha)
  - ✓ estimate pasture energy content (MJ ME/kg DM or simply/d)

- **Animal assessment**
  - ✓ individual and average initial body condition (fat) score
  - ✓ current field estimate of range in condition score
  - ✓ weight of animal at last weighing
  - ✓ current field estimate of weight range
  - ✓ current live weight

Operation Sheet 1. Hay making

Objectives

To bridge the gap between surplus forage production time and dry period when all feeds dried

Procedure of hay making

1. prepare the necessary materials and PPE
2. Harvest the crop after the dew is dried up /as the condition may be
3. Turn over the fodder with the help of a take after 4-5 hours in case good sunshine is available. Turning 2-3 times a day is essential
4. Dry the fodder for 3-4 days until the moisture content is below 15%
5. Roll the crop in to smaller heaps at more time under the sun and to avoid leaf shading
6. Cure the crop for the whole day after rolling it in to smaller heaps
7. Finally store as loose bundles or keep in balled forms with the help of bailer
8. Record and report your findings to the supervizer or instructor

Operation Sheet- 2	Silage Making

Steps

1. Select suitable personal protective equipment (PPE) and wear it
2. Harvest at optimum stages of Maturity on the Good day
3. Chop it to required size for conservation
4. Pack it in the previously prepared pit by removing the air from it by compact
5. Cover it with appropriate Thatch or plastic sheets
6. Keep it air tight and provide for the animals starting from 21 days (Take care of The poisons developed due to Molds and an appropriate storage)
7. Record and report your findings to the supervizer or instructor

LAP Test	Colony inspection to assess pests and diseases

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Use personnel protective equipment,

Given necessary templates tools and materials you are required to perform the following tasks within **10** hours.

Task 1. conduct hay making

Task 2. Conduct silage making

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