Ethiopian TVET System

Animal Production Level-II

Training Module –Learning Guide 44-47

Based on Version 3 March 2018 Occupational Standard (OS)

Unit of Competence: **Participate in forage development**

UC code: AGR APR2 13 0318

Module Title: **Participating in Forage Development**

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Module Title: Participating in Forage Development

TTLM Code: AGR APR2 TTLM 0919V1

This module includes the following Learning Guides

LG44: Prepare site for forage development

(LG Code: AGR APR2 M14 0919 LO1- 44

LG45: Undertake forage development activities.

(LG Code: AGR APR2 M14 0919 LO1-45

LG46: Perform harvesting operations.

(LG Code: AGR APR2 M14 0919 LO1-46

LG47: Clean up on completion of work.

(LG Code: AGR APR2 M14 0919 LO1-47

Instruction Sheet	Learning Guide # 44

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

- preparing materials, tools, equipment and machinery
- carrying out site selection and land preparation
- identifying and defining types of forages
- determining forage development options
- identifying risk factors
- confirming soil conditions for forage production

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 materials, tools, equipment and machinery
- carry out site selection and land preparation
- identify and defining types of forages
- determine forage development options
- identify risk factors
- confirm soil conditions for forage production

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3, Sheet 4, Sheet 5 and Sheet 6.
4. Accomplish the “Self-check 1, Self-check t 2, Self-check 3, Self-check 4, Self-check 5 and Self-check 6” **in page -7, 11, 15, 23, 25 and 28** respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1” **in page -29.**
6. Do the “LAP test” **in page – 29** (if you are ready).

Information sheet – 1	Preparing materials, tools, equipment and machinery

1.1. General concepts to forage development

Livestock production is an integral part of the farming systems in Ethiopia and plays a vital role in the livelihood of the majority of the people. The sector contributes to national economy 15 to 17% of gross domestic product (GDP) and 35 to 49% of agricultural GDP and 37 to 87% of the household incomes and the share to total exports is about 16%. Livestock have multiple uses such as income generation, cash storage, draught and pack services, milk and meat for household consumption, and manure for fuel and fertilizer. Despite the large number of livestock resources the country own, its productivity is extremely low. The major constraint to such low productivity is shortage of livestock feeds in terms of quantity and quality, especially during the dry season. Even during years of good rainy season, forage is not sufficient to feed livestock for reasons associated with restricted grazing land and poor grazing management.

The role of natural pasture grazing as a source of livestock feed has begun to decline from time to time due to shrinking grazing land size as a result of increased areas of cultivation, increase in human and livestock population and changing patterns of land use. An adequate supply of livestock feed is crucial to the livelihoods of millions of people across the developing world, and not just for smallholders, but also for pastoralists and the large number of landless who depend mainly on common land for grazing. A basic shortcoming of the natural grasslands as a source of feed for ruminant livestock are low production of dry matter and nutritive value due to a combination of the negative effects of inadequate rainfall and soil nutrients.

Feed is the most important input in livestock production and its adequate supply throughout the year is an essential prerequisite for any substantial and sustained expansion in livestock production to support the livelihood of millions of smallholders, pastoralists, and others people across the developing world that depend on livestock rearing. However, the main feed resources for livestock in Ethiopia are natural pasture and crop residues, which are low in quantity and quality for sustainable animal production. The availability and nutritional quality of

the available feed resources are among the most important factors that determine the productivity of livestock.

As a result providing a proper nutrition to animals, especially during the dry season when pasture and cereal residues are limiting both in nutritional quality and quantity remain to be the problem faced by livestock producers in the tropical countries. Low quality feeds are associated with a low voluntary intake, thus resulting in insufficient nutrient supply, low productivity and even weight loss and animals are not able to meet even maintenance requirements and lose substantial amount of weight. It is important to increase the pasture yield and nutritive value of the plant (CP content and digestibility), which can improve livestock production.

Shortage of feeds is exacerbated by the increase in human and livestock population and expansion of croplands, resulting in decrement of grazing lands. In such situation, improved forage options that address yield and nutritive value issues are needed to increase livestock productivity. This requires introduction of high quality cultivated forage with high yielding ability and adaptability to the biotic and abiotic environmental stresses. A number of important improved forage has been generated by the research systems over the last years in the country.

1.2. Identifying and preparing tools, materials and equipment

There are different materials, tools and equipment used for forage development may include:-

- **Tools** are objects designed to do a specific kind of work such as cutting or chopping by directing manually applied force or by means of a motor.
- **Equipment** is necessary items such as the tools, clothing, or other items needed for a particular activity or purpose.
- **Materials** are something used in making items or things

The following tools & equipment are used for pasture establishment and preservation work:-

- Hoe
- Sickle
- Meter
- Tractor with its accessories

- Combine harvester
- Disk
- Barrel
- Weighing scale
- Graduated cylinder
- Watering can
- Silo
- Store

Forage chopper

- Chopper
- Watering plastic tube

- Spade
- Wheel barrow
- Bailer

- Shovel
- Rack
- fork
- Water pump

- Axe
- Peg
- Hammer

Materials includes the following

- Rope
- Standing hay
- Hay
- Silage
- Urea/ fertilizer
- Molasses
- Salt
- Fuel
- Feeds
- Seed
- Seedling
- Grass cut
- Empty sack
- Plastic sheet

Self-Check-1	Written Test

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

1. List tools and materials that used for forage development. (3 points)
2. Why natural pasture grazing as a source of livestock feed decline through time? (4 points)

Note: Satisfactory rating – 5 points unsatisfactory rating –below 5 points

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

Answer Sheet

Score: _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions:

1._____

2._____

Information sheet – 2	Carrying out site selection and land preparation

Preparation for pasture establishment needs to begin at least one full year before the seed is actually sown. Basically the establishment of forage crops begins with the proper soil environment. Soil test indicate whether the PH of the soil is suitable for maximum production. Under most situations, the optimum PH value should fall between 6.5 and 7.5. In addition to the PH value the availability of elements such as phosphorous, potassium, calcium, magnesium and other trace elements in the soil are needed for proper growth.

Pasture establishment procedures may include in developing a pasture establishment program requires evidence that a person can assess site factors, select suitable pasture species and cultivars, determine resources and equipment for planting and post-planting care, and prepare pasture establishment plans to meet livestock production plans and schedules.

A. Site selection- Forage seed production sites must be accessible and as much as possible located in lands suitable for cultivation, irrigation, and fertilizing. Other ecological requirements for a suitable site include:

- ✓ A climate and soil suitable to most elite forage species or at least the target species.
- ✓ Soil fertility: Improved forages can behave as food crops in soil-fertility requirements.
- ✓ The area must be free of noxious, weeds, pest and diseases.
- ✓ Adequate space to make isolation possible for multiplying cross-pollinated species.
- ✓ Adequate growing season with ample rainfall.
- ✓ Access to irrigation to make multiple harvests possible and guarantee against fluctuating rain distribution.
- ✓ Topography: Must be convenient for easy farm operation (cultivation, fertilizing, spraying, harvesting, etc.), and convenience for grazing animals (if grazed pasture).Free from frost: ensure the site is not located in a frost-pocket in the landscape.

- ✓ Sunny weather during flowering to initiate reproductive development, flower opening, pollination and facilitate seed harvesting.

When assessing a locations potential for pasture production, it is important to consider the following site selection characteristics:-

- ✓ **Annual precipitation;-** Available soil moisture is the limiting factor for plant growth and establishment .sites with less precipitation have limited productivity and may not provide the site should adequate economic return. Therefore the site with adequate annual precipitation should be selected. Most dry land forage species require at least twelve inches of annual precipitation for adequate growth and long term survival.
- ✓ **Soil depth; -** To provide sufficient water holding capacity for productive plant growth, the soil depth must be at least eighty inches.
- ✓ **Soil texture; -** Soil texture and depth determine a soil's water holding capacity and therefore strongly influence a site's potential for forage production. Soil texture ranging from a sandy loam to silt or clay loam is most suitable for plant growth.
- ✓ **Drainage; -** Most forage species thrive in well-drained soils that have no shallow sub surface restrictive layers. The common types of restrictive layer are clay lenses and volcanic ash layers.
- ✓ **Salt accumulation; -** Salt affected soils present several problems for pasture establishment. The accumulation of salt in soils has negative influences on several soil properties, including soil structure, water infiltration and nutrient availability.
- ✓ **Freedom from rocks;-** The presence of large rocks in the soil rules out most cultivation and planting options and significantly reduces the potential for success in establishing pasture.
- ✓ **Slope; -** Slopes should be less than 15% in order to accommodate planting and soil preparation equipment and minimize the potential for erosion.
- ✓ **Freedom from over story vegetation; -** Dense over story vegetation should be removed or thinned both to decrease competition for moisture and light and to reduce the potential for soil erosion.

B. Land preparation activities include **land clearing** and **seed bed preparation**:-

Preparation of a good seedbed (the smaller the seed the finer the seedbed), sown grasses and legumes require a finely granulated soil surface which is firm and free from weeds. Sowing shortly after the rains begin takes advantage of soil nitrogen made available by mineralization. However, it also coincides with the period of heavy downpours and strong weed competition. Excessive downpours may wash seeds away or cover them too deeply. Also the first rains may be intermittent and unreliable and resulting short drought periods may affect seedling survival. Tree or shrub removal is always one of the first steps. However trees should not be removed if the trees are important as browse species or needed for shade, if the land is sloping and there is a danger of erosion and if they are protecting water courses.

- ✓ **Land clearing; -** It refers to the activities to remove all unwanted plant materials and other things from the land. It refers to avoiding or cutting all undesirable, trees, bush, grass and any other waste materials from the selected site.

  The land can be cleaned by hand cutting, by fire and by using land clearing machines like dozer.

  The main methods of **land clearance** include:
  - Mechanical movement of trees and shrubs - manually by knives and saws or by machine.
  - Chemical treatments (2,4,5-T or 2,4-D, mixtures of these, picloram, fenuron, arsenic, etc. can all be useful herbicides for killing tree stumps. Chemicals can be injected into the tree by using an axe with a cylinder attached which delivers herbicide to the axe blade. Aerial herbicide spraying is also possible.
  - A combination of mechanical and chemical or mechanical and burning
  - Regular burning (if allowed by law).
- ✓ **Seed-bed preparation; -** Pastures usually require a well- prepared seed –bed for good germination and establishment. Good seed-to-soil contact is essential to maintain adequate moisture near the seeds. This moisture is necessary for germination and for the small root systems of young grass seedlings. The type of seedbed preparation that is chosen will

depend on the type of equipment available and whether a new pasture is being established (conventional tillage) or an existing pasture is being renovated (no-till drill). Two methods of seed –bed preparation are recommended.

Soil tillage: consists in breaking the compact surface of the earth to the certain depth and to loosen the soil mass, so as to the roots of the crops to penetrate and spread in the soil. Tillage may be called the practice of modifying or mechanical manipulation of the status of soil to provide favourable condition for plant growth. Tillage operation is most labour consuming and difficult operation, as compared to all subsequent operations in the field.

Self-Check -2	Written Test

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

1. List requirements in site selection for forage development (4 points)
2. Mention site selection characteristics for forage development (6 points)
3. List methods of land clearing for forage development (5 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: _____

Name: _____ Date: _____

Short Answer Questions:

1._____

2._____

3._____

Information sheet – 3	Identifying and defining types of forages

3.1. Classification of forages

Forages can be broadly classified in the two

Grasses

All grasses are members of the family Gramineae. They are monocotyledons (i.e. the embryo of a grass seed contains a single cotyledon or seed leaf). The basic design of a grass is simple.

It has:

- Roots anchoring the plant in the soil
- Cylindrical jointed stems consisting of nodes and internodes
- Alternately positioned leaves consisting of leaf sheaths and leaf blades with the sheath encircling the stem
- An inflorescence spike consisting of several flowers from which seeds develop.

Grasses can be annual or perennial. Annuals complete their life-cycles in one year while perennials survive for more than 2 growing seasons. Almost all grasses are herbaceous (non-woody) plants.

Examples: Annual: maize, sorghum, cumbu

Perennial: guinea grass B.N. hybrids

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 dicotyledons 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. This relationship between the host plant and the rhizobium is a symbiotic relationship which benefits both the plant and the bacterium. The rhizobium takes up atmospheric nitrogen and fixes it, transforming it into a form which can easily be taken up by the host plant. In return the legume provides nutrients and energy to the bacteria. It is this relationship that gives legumes such a great advantage over other species, enabling it to grow in highly infertile soils which could support few other plant species. These species can grow in the absence of rhizobia but their growth is stunted and weak.

Some of the fixed nitrogen finds its way into the soil and from there to associated plants and succeeding crops or may be ingested by animals. When a legume is incorporated into a pasture mixture, provided it is nodulated by an effective strain of rhizobium and is growing vigourously, it is a valuable source of protein in animal diets and also useful for soil fertility building. It is a cheap and useful source of nitrogen.
In summary, it can be said that the 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. Examples include Cajanus cajan (pigeon pea) and 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. Examples are 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 species.

4. Scrambling

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

5. Rosette

The **rosette** is a vegetative form of some perennials developed after flowering or with the onset of cool weather. Examples include Medicago sativa and Trifolium pratense. Because of the wide range of altitudes, soils, rainfall, existing management systems, etc. a wide range of pasture and forage species are found within Ethiopia and a wide range of exotic forage species are potentially very suitable for introduction to Ethiopia.

3.2. Seedling stage and young plant growth

Grasses when sowing conditions are optimal the emergence of grasses takes place 5 or 6 days after sowing. The time will increase (i.e. 10 - 14 days) if conditions are not optimal. The endospermic reserves feed the young plant for the first 7 to 10 days of its growth. As soon as light touches the coleoptile photosynthesis begins. The leaves appear at a linear rate with time

and tillering. After 2 or 3 weeks stolon's and rhizomes start to develop but this timing is species specific.

Legumes under optimal conditions legumes emerge 3 to 5 days after planting. When the conditions are not optimal the time between planting and emergence may be 15 days or more. When developed cotyledons are green they play a role in the first photosynthetic activities of the new plant. The first 3 leaves usually appear in 10 to 12 days with lateral branches appearing about 2 weeks late

Self-Check -3	**Written Test**

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

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

Note: Satisfactory rating – 7 points unsatisfactory rating –below 7 points

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions:

1._____

2._____

3._____

Information sheet – 4	Determining Forage development options

4.1. Improved Forage Production Strategies

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. This is indicated in the following diagram showing the existing feed situation and possible forage development strategies.

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:

On Farm Strategies	Common Land Strategies

• Backyard Forage Production • Under sowing and Inter planting • Countour Forage Strips • Agroforestry	• Over sowing Common Grazing Areas • Stock Exclusion Areas/Forage Banks • Permanent Pastures

4.1.1. 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. Woody leguminous browse species are particularly suited to this strategy because of their multipurpose benefits and rapid growth rates. Tall growing tropical grasses are also suited to backyard forage development. Tree legume hedges have been the most widely adopted backyard forage strategy and need to be used as an incentive for broad-scale forage development based on contour forage strip and under sowing strategies. This strategy introduces farmers to the concept of supplementing crop by-products and poor quality roughages with high quality forage in a location, which facilitates close attention to management.

Backyard forage provides significant quantities of both forage and fuel wood where they can be conveniently used. Other benefits perceived by farmers include shelter, increased privacy, wood products construction and implements, and bee products. The multipurpose benefits of backyard forages provide a range of incentives for farmers to adopt this strategy. Backyard forage can be cut and carried to tethered or housed animals, or cut and conserved for dry

season use in mixes with crop residues and natural pasture hay or roughages. The backyard forage strategy provides an opportunity to reach large numbers of farmers very quickly and can therefore have a great impact nationally, even in the short term. Demonstrations of about 100 browse legume.

4.1.2. Under sowing and Inter planting

Under sowing and inter planting is the establishment of forage species in an annual crop or perennial plantation. This strategy provides the most convenient approach to rapidly increasing on-farm forage supplies over a large number of farmers and should have a major impact in the short to medium term. The use of legumes in this system will contribute to the improved fertility and structure of cropping soils. Farmers seeing on-farm trials of under sowing and inter planting accept the strategy readily and understand the benefits and techniques very quickly. This is normally the second strategy to promote after backyard forage has been adopted by farmers. Under sowing and intercropping are probably the most important of the forage development strategies. Under sowing works best with sprawling, low growing annual legumes but can also work well with climbing legumes. The strategy is particularly suited to the production of tall growing cereals such as maize, sorghum or millet but also works with other cropping systems. Under sowing with legumes produces large quantities of high quality forage for utilization by either postharvest grazing or cut and carry systems. 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.

4.1.3. 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. This increases infiltration and reduces soil erosion, especially where a thick sward of grass or herbaceous legumes is included in the forage strip. Contour forage strips are particularly successful when perennial, thick rooted grasses are mixed with woody leguminous species. Because this strategy integrates forage production in cropping areas, potentially weedy species such as stoloniferous grasses should not be used for forage strip plantings.

4.1.4. 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. Many of the forage production strategies can be developed as agroforestry systems. In particular contour forage banks and under sowing of tree crops or forest plantations can be designed as agroforestry systems where leguminous browse species provide an upper story in a forage system or under sown legumes and grasses provide an under story in a forestry or horticultural system. Agroforestry maximizes the use of land by adding a third dimension to the above and below ground areas of utilization. This aspect is particularly important for farmers with limited land resources. Because many agroforestry strategies include leguminous species, they are also attractive to farmers facing problems of declining soil productivity.

4.1.5. 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. Typically there is no attempt to modify grazing management but existing stocking rates should not be increased after over sowing. The strategy includes sowing

roadsides from vehicles and is suited to aerial seeding where very large areas are to be developed. Aerial seeding is also another way of establishing improved extensive grazing areas using over sowing techniques. This strategy is most suited to pioneer legume species, which grow quickly and seed prolifically. Because of the low input nature of this strategy, incremental forage yields are not large but pioneer species with good grazing tolerance and natural seeding ability gradually colonize common areas and improve the overall species composition available for grazing. Natural spread of seed with water movement, grazing animals and wind action can be rapid, enabling very large areas of land to be developed so long as grazing management is possible to enable plants to become established and set seed.

4.1.6. 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. Stock exclusion areas are particularly important for the conservation of highlands but are only accepted by farmers where they see sufficient benefits to organize grazing management groups or pastoral associations to control stock exclusion areas and voluntarily keep stock out. The introduction of browse species, productive legumes and improved grasses can rapidly increase the productivity of exclusion areas. The strategy is suitable for aerial seeding techniques which enable very large areas of land to be sown to forage quickly. Rehabilitation of degraded areas using forage species normally provides a good incentive for farmers and pastoralists to organise grazing management groups or pastoral associations. Because degraded land has low value as a common grazing resource farmers are usually willing to voluntarily exclude livestock from these areas. Rehabilitation of degraded areas with forage species provides an incentive for these initiatives, especially when farmers understand the benefits of forage development. Without farmer initiated grazing management groups or pastoral associations to control grazing, stock exclusion areas and forage banks are unsustainable. The extension effort therefore needs to focus on the benefits of collaborative management of common lands and initially focus on degraded areas where benefits will be maximized and the likelihood of farmer resistance will be

minimal. Cultivation is not necessary to establish forage banks or rehabilitate stock exclusion areas, especially on very bare sites, but broadcast sowing should take place after commencement of the main rains to ensure that there is enough soil moisture to sustain germination. Direct seeding with chisel tyned cultivators may be necessary in degraded areas with scalded or hardpan surfaces. Leguminous browse and tall grass species should always be included in stock exclusion areas to maximize the production potential and drought resistance of the species mix. Woody species can be planted by direct seeding but generally develop more successfully where they are planted as bare rooted seedlings early in the main rainy season.

4.1.7. 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. Grazing management is a significant problem for sustainable pasture productions in some regions, which is best overcome with cut and carry systems. Permanent pastures are most useful for dairy farmers who rely on optimal productivity of their livestock investment for their livelihood. Permanent dairy pastures should include a mix of legumes and grass species with high palatability and productivity.

4.1.8. 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. Sowing a broad grid of suitable roads provides a convenient mechanism for introducing improved forage species to a large area since the rate of spread from a very long narrow transects is high. 10 km of roadside sowing equates to about one hectare of over sown grazing land. Seeding rates are typically 0.5 to 1.0 kg per kilometer of roadside. Mixed seed should be emptied from sacks or buckets from the back of a reasonably

fast moving vehicle. In this way the vortex currents carry seed onto the roadside verge. Roadside sowing is most suitable for quickly establishing and prolific seeding species, which tolerate grazing. The stylos are the most successful species used in roadside sowing in Ethiopia.

4.1.9. Aerial 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. The most suitable sites have rough often gravelly surfaces. Sites with compacted or hardpan surfaces do not enable good establishment of aerial sown or broadcast seed. *Stylosanthes* are particularly successful for aerial over sowing – being extremely resilient to grazing and a successful pioneer species. Aerial sowing is particularly suited to the rehabilitation of large catchments, which include relatively inaccessible areas. Where grazing is restricted or there are protected niches because of thorn bushes or rocks, leguminous browse species should also be included in aerial sowing mixes. *Leucaena* is especially appropriate for this purpose. Seed is best dispersed from fixed wing aircraft, which travel at sufficient speed to create air currents for seed dispersal. If helicopters are used, spinners are normally required for efficient seed distribution. Flag bearers on the ground or the use of prominent landmarks are necessary to plan and manage aerial seeding operations.

4.1.10. 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. The advantages of this system are primarily to provide high-quality fodder and maintain soil fertility. Interspersing a legume in the crop rotation enhances soil fertility, prolongs the cropping period and reduces the normal fallow time traditionally used to replenish soil fertility. Legume crops also reduce the use of high amounts of chemical fertilizers. Thus, the method

minimizes expenses for commercial fertilizers, especially nitrogen, which is fixed from atmospheric sources through Rhizobial fixation

.

4.1.11. 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 -4	Written Test

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

1. Mention on farm strategies in forage development strategies (5 points)
2. List advantages of backyard forage production in forage development strategies (3 point)

Note: Satisfactory rating – 5 points unsatisfactory rating –below 5 points

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions:

1._____

2._____

Information sheet – 5	Identifying risk factors

Risk factors that consider during forage development may include fire, vermin/pests, flood, over matured of pasture, overgrazing, weed, shattering, leaching, bleaching, moulds, etc. A mixture of species should be selected for each agro-ecological zone to ensure biodiversity and thus minimize the risks from pests and climatic extremes. Utilization of developed foraged at optimum time and stage is one of the crucial ways to reduce risks associated with forage development. Also balancing between nutrient content and yield of forage one of the considerations to reduce risk related less nutrient content of forage types. Start from site selection, soil sampling and land preparation requires especial attention to keep balance between quality and yield of pasture as well as animals become better productive.

According to forage development enterprise every activities starting from site selection until supply to animals as feed requires professional attendant. Types of forage and ways of utilization of developed forage (grass only, grass-legume mix, legume only, legume-fodder trees, etc.) are one of the methods to be used as animal productivity improvement. Harvesting at optimum time and using different feeding or grazing methods or otherwise storing in clean and dry places reduce risks. Harvesting forages at early stage leads in to an increment of yield but reduces in nutrient contents and similarly harvesting at late stage causes reduces nutrient content but increase in quantity.

Self-Check -5	Written Test

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

1. Mention risks that associated in forage development (4 points)

List ways of reducing risks associated with forage development (6 points.)

Note: Satisfactory rating – 7 points unsatisfactory rating –below 7 points

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions:

1._____

2._____

Information sheet – 6	Confirming soil conditions for forage production

Soil fertility affects forage yield much more than it does quality. While it is possible to produce high quality forage on poor, unproductive soils, it is generally very difficult to produce high yields of high quality forage with an unproductive soil resource. Proper soil phosphorus (P) and potassium (K) levels help to keep desirable legumes in a mixed seeding and also reduce weed problems. It is necessary to balance soil fertility to avoid mineral imbalances in ruminants. Low soil fertility, as well as very high fertility, has resulted in reduced forage quality.

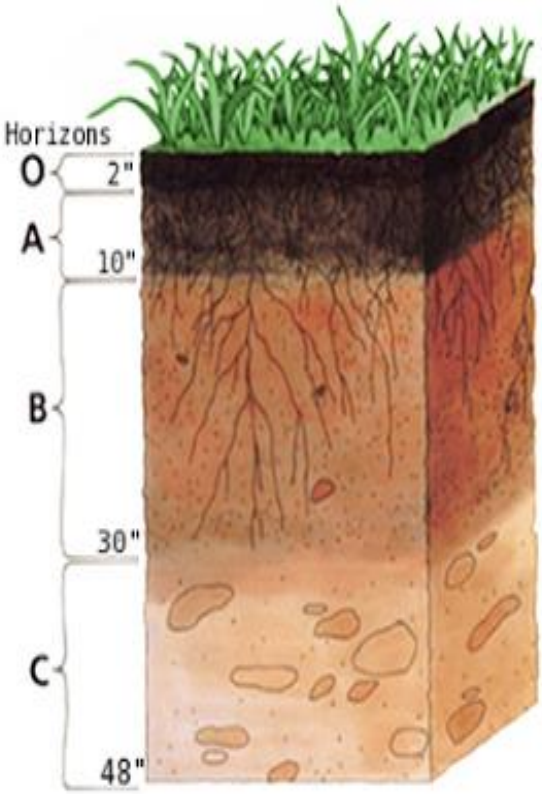
Soil is an unconsolidated, or loose, combination of inorganic and organic materials. The inorganic components of soil are principally the products of rocks and minerals that have been gradually broken down by weather, chemical action, and other natural processes. The organic materials are composed of debris from plants and from the decomposition of the many tiny life forms that inhabit the soil. Soil actually constitutes a living system, combining with air, water, and sunlight to sustain plant life. The essential process of photosynthesis, in which plants convert sunlight into energy, depends on exchanges that take place within the soil. Without soil there would be no vegetation—no crops for food, no forests, flowers, or grasslands.

Composition of soils

- Soils comprise a mixture of inorganic and organic components: minerals, air, water, and plant and animal material.
- Mineral and organic particles generally compose roughly 50% of a soil's volume.
- The other 50% consists of pores-open areas of various shapes and sizes.
- Function of soil pore-open:-
    - ☞ hold water within the soil

- provide a means of water transport
- move oxygen and other gases easily
- serve as passageways for small animals
- provide room for the growth of plant root

Soil Profile



Most soils have three major horizons --
the surface horizon (A)
the subsoil (B),
and the substratum (C)

Some soils have an organic horizon (O)
on the surface, but this horizon can also be buried.

The master horizon, E, is used for horizons that have a significant loss of minerals (eluviation).

Hard bedrock, which is not soil, uses the letter R.

Self-Check -6	Written Test

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

1. What are the nutrient contents of soil? (4 points)
2. List types of soil composition (3 point)
3. Mention function of soil pore-open (5 points)

Note: Satisfactory rating – 8 points unsatisfactory rating –below 8 points

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions:

1._____

2._____

3._____

Operation sheet -1	Procedures in carrying out site selection and land preparation

Techniques to select and prepare land for forage development as follows:-

Step 1: Select site / area

Step 2: Clean & prepare land for pasture establishment

Step 3: select & prepare certified seed for forage establishment

Step 4: Sow

Step 5: Weeding & harvest on time depending on forage species

Step 6: Conserve as hay & silage

Step 7: Feed to livestock depending animal body condition

LAP Test	Practical Demonstration

Task. Select site and prepare land for forage development

REFERENCE

Duguma Gemeda. 2010. Participatory definition of breeding objectives and implementation of community based sheep breeding programs in Ethiopia. PhD Thesis, University of Natural Resources and Life Sciences, Vienna, Austria.

Muhammad, R. 2016. Elephant grass as forage for ruminant animals. Department of Forage Crops and Grassland Management, Faculty of Animal Science, Hasanuddin University, Indonesia

Instruction Sheet	Learning Guide # 45

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

- Following and clarifying Instructions and directions
- Undertaking forage development activities
  - Applying different forage seed sowing methods
  - Identifying and applying fertilizer and irrigation/watering
- Recording Seasonal growth pattern of forage crop for harvesting time
- Undertaking seed selection and treatment techniques
- Setting Pests, weeds and diseases control methods

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 –

- follow and clarify instructions and directions
- undertake forage development activities
- record seasonal growth pattern of forage crop for harvesting time
- undertake seed selection and treatment techniques
- sett pests, weeds and diseases control methods

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3, Sheet 4 and Sheet 5
4. Accomplish the “Self-check 1, Self-check t 2, Self-check 3, Self-check 4 and Self-check 5” **in page -4, 12, 15, 22 and 25** respectively.

5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1” **in page - 26.**
6. Do the “LAP test” **in page – 26** (if you are ready).

Information sheet – 1	**Following and clarifying Instructions and directions**

Any employee who works in forage development or any farmer who establish Pasture must follow the following instruction and direction:-

- Forage enterprise policies and procedures
- Manufacturer instructions
- Material safety data sheets (MSDS)
- OHS standards and procedures
- Specifications for tools, equipment’s and materials
- Standard Operating Procedures (SOP)
- Verbal directions from manager or supervisor
- Work instructions and standards
- Work notes.

Instructions and directions provided by supervisor must be followed and if we have any question we can ask when necessary. And also employee must observe and follow Enterprise policies and procedures in relation to workplace practices in the handling and disposal of materials.

Self-Check-1	Written Test

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

List instruction and direction for forage development. (6 points)

Note: Satisfactory rating – 4 points unsatisfactory rating –below 4 points

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions:

1._____

Information sheet – 2	Undertaking forage development activities

Undertaking forage development activities may include determining seeding rate, maintaining forage, land preparation, seed selection, seed treatment, mulching, sowing, ploughing, furrowing, weed control, transplanting, fertilizer application and irrigation /watering, etc.

Ploughing

A **plough** or **plow** is a tool or farm implement used for initial cultivation to loosen or turn the soil in preparation for sowing seed or planting. Ploughs were traditionally drawn by working animals such as oxen and horses, but in modern farms are drawn by tractors. A plough may be made of wood, iron, or steel frame with an attached blade or stick used to cut and loosen the soil. It has been a basic instrument for most of history, and is one of the most significant inventions. The earliest ploughs were wheel less, with the Romans using a wheel less plough called the *aratrum*, but Celtic peoples began using wheeled ploughs during the Roman era.
The primary purpose of ploughing is to turn over the upper layer of the soil, bringing fresh nutrients to the surface, while burying weeds and the remains of previous crops and allowing them to decay. As the plough is drawn through the soil, it creates long trenches of fertile soil called furrows. In modern use, a ploughed field is typically left to dry out, and is then harrowed before planting. Ploughing and cultivating a soil homogenises and modifies the upper 12 to 25 centimeters (5 to 10 in) to form a plough layer, where the majority of fine plant feeder roots grow.

Ploughs were initially human-powered, but the process became considerably more efficient once animals were pressed into service. The first animal-powered ploughs were undoubtedly pulled by oxen, and later in many areas by horses and mules, although various other animals have been used for this purpose. The industrial revolution brought steam engines to pull

ploughs, ploughing engines or steam tractors, which were gradually superseded by internal-combustion-powered tractors. Use of the plough has decreased in some areas, often those significantly threatened by soil damage and erosion, in favour of shallower ploughing and other less-invasive conservation tillage techniques.

Mulching

Mulch is a layer of material applied to the surface of soil. Reasons for applying mulch include conservation of soil moisture, improving fertility and health of the soil, reducing weed growth and enhancing the visual appeal of the area. Mulch is usually, but not exclusively, organic in nature. It may be permanent (e.g. plastic sheeting) or temporary (e.g. bark chips). It may be applied to bare soil or around existing plants. Mulches of manure or compost will be incorporated naturally into the soil by the activity of worms and other organisms. The process is used both in commercial crop production and in gardening, and when applied correctly, can dramatically improve soil productivity.

Transplanting

Transplanting or **replanting** is the technique of moving a plant from one location to another. Most often this takes the form of starting a plant from seed in optimal conditions, such as in a greenhouse or protected nursery bed, then replanting it in another, usually outdoor, growing location. This is common in market gardening and truck farming, where setting out or planting out are synonymous with transplanting. In the horticulture of some ornamental plants, transplants are used infrequently and carefully because they carry with them a significant risk of killing the plant.

Transplanting has a variety of applications, including:

- Extending the growing season by starting plants indoors, before outdoor conditions are favorable;

- Protecting young plants from diseases and pests until they are sufficiently established;
- Avoiding germination problems by setting out seedlings instead of direct seeding.

Different species and varieties react differently to transplanting; for some, it is not recommended. In all cases, avoiding *transplant shock*—the stress or damage received in the process—is the principal concern. Plants raised in protected conditions usually need a period of acclimatization, known as hardening off (see also frost hardiness). Also, root disturbance should be minimized. The stage of growth at which transplanting takes place, the weather conditions during transplanting, and treatment immediately after transplanting are other important factors.

Applying different forage seed sowing methods

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.

Method of sowing

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

Row-sowing is preferred 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 &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

Identifying and applying fertilizer and irrigation/watering

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 diammonium 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.

Applying irrigation/watering

Irrigation schedules, where required, are determined for each soil and crop/pasture type based on assessed water requirements, rainfall and evapo-transpiration data. All plants require water. Some are more drought tolerant than others. Some can survive on rainfall alone, whereas others have very high demands for water at specific times in the growing cycle. These plants require an irrigation system to provide water at the right place, at the right time and in the right

quantities. The use of natural resources in the agricultural sector is coming under increasing scrutiny by regulators and the community.

There are a number of irrigation methods used, including flood, hand line, wheel line, gated pipe, little and big gun, linear, and pivot irrigation systems. The method of choice depends on the system that came with the farm, the size of the farm and the amount of labor, time and money available.

Determining when to irrigate and how much water to apply are specialized tasks. Though many techniques exist, monitoring soil moisture may be the easiest irrigation scheduling technique. This technique can help you determine when to irrigate, whether irrigation periods are sufficiently spaced, and whether the proper amount of water is applied during each irrigation time. See the resources for more information that the end of this article for a useful field test for estimating soil moisture. During the growing season, the soil should dry out to about 50% of the soil water hold capacity before it is irrigated back to its capacity. Water holding capacity is a determined by soil texture, organic matter content, and soil depth. The time between irrigations varies depending on the time of year.

Moisture evaporates from the soil and plants are said to transpire, that is, they give off moisture through their leaves. Considered together, these two processes are referred to as evapotranspiration. Evapotranspiration or average daily water loss from the soil plant system varies by season. As you might guess, water losses are greater during the hot, dry, longer days of summer than at any other time of year.

If your goal only is to have a green pasture, irrigate whenever the weather is dry. If you irrigate for production, follow an irrigation management plan based on the infiltration rate, water-holding capacity of the soil, and amount of moisture lost to evapotranspiration. Use weather and soil information to ensure adequate but not excessive irrigation..

Do not leave large livestock in the pasture while irrigating; they may damage equipment. To avoid plant damage and soil compaction, wait 3 or 4 days after irrigating before turning large livestock back onto pastures. As always, wait until the pasture is above 6 to 8 inches in height before grazing, and graze no shorter than 3 inches.

Irrigation is artificial watering of land to sustain plant growth.

It is practiced in all parts of the world where:-

- Rainfall does not provide enough ground moisture
- In areas of irregular rainfall
- During dry spells to ensure harvests and to increase crop yields

It has greatly expanded the amount of arable land and the production of food throughout the world.

Irrigation methods:-

- Sprinklers
- Flooding
- Furrow irrigation
- Drip or trickle irrigation

Self-Check -2	Written Test

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

1. Reason out why mulching carry out in forage development? (4 point)
2. List methods of sowing forage seed (3 point)
3. List different types of irrigation methods for forage development (5 point)

Note: Satisfactory rating – 8 points unsatisfactory rating –below 8 points

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions:

1._____

2._____

3._____

Information sheet – 3	Recording Seasonal growth pattern of forage crop for harvesting time

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.

✓ **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.)

✓ **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)

- 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 -3	Written Test

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

1. List characteristics of annual and perennial forage development (10 points)
2. Give an examples for perennial grass species (10 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: _____

Name: _____ Date: _____

Short Answer Questions:

1._____

2._____

Information sheet – 4	Undertaking seed selection and treatment techniques

Before sowing it is useful to determine the viability of the seeds (if not commercial and guaranteed) by carrying out a germination test. Some seeds may also require seed treatment and inoculation (only legume seeds).

4.1. Seed quality test

There is a need to use high quality seed to establish the pasture. Quality is measured in terms of purity and germination. If commercial seed is considered, it is fair to request for a recent seed analysis statement for the seed to be sown, since this will show the quality details. Purity is expressed in terms of the percentages of seed of the sown variety, other crops and weeds, of inert matter (including pieces of straw, soil etc.), and of broken seed. Special attention must be given to the weed seed in the sample so as not to introduce new, potentially serious weeds into the pastureland.

Seed quality is an important parameter to look into before sowing of seeds. This seed quality is defined first by the proportion of seeds which will germinate and secondly by the freedom of the seed from contamination by seeds of different genetic constitution, by inert material or by pests and diseases. Other considerations before sowing of a seed include viability, longevity in storage, vigour, germination rate, dormancy, origin and size of the seeds.

- **Viability** is the capacity of the seeds to germinate after sowing. When the seed (comprising an embryo and endosperm energy reserves, surrounded by a seed coat or test and other outer coverings) is placed in a moist environment falling within a specific temperature range, it absorbs moisture and various biochemical changes begin. Clearly a high content of dead seed which will not germinate represents a loss to the purchaser and many countries lay

down minimum standards of seed viability which the supplier of the seed is required to meet. For this reason a simple germination test is necessary.

- **Rate of seed germination**

A rapid rate of seed germination is often beneficial to field establishment. Competition with fast germinating weeds or survival before soil drying are both favored if the seeds sown germinate quickly. This can be considered as the probability of a proportion of seeds in a seed lot germinating in a given period of time and should not be confused with the total viability of the seed lot. Rate of germination may be broken up into two independent periods: the latent period from the onset of imbibition's to the visible bursting out of the radicle in the first germinating seeds, and the subsequent germ ability of the sample. Therefore, seed testing data which give an indication of the rate of germination will help the seed user buy seed with good establishment prospects.

Germination test procedures

- ✓ Place the blotting paper in the germination tray (shallow dish) and moisten it. Do not wet the paper;
- ✓ Place 100 seeds in the tray, scattering them evenly along the shallow dish;
- ✓ Keep the tray at room temperature;
- ✓ Keep the blotting paper moist all the time
- ✓ Check the seeds once a day and count the germinated ones
- ✓ Continue this for a week
- ✓ Express the number that sprouted on percentage basis
- ✓ Make three replications or repeat it three times

- **Contamination (purity) analysis**-The forage seeds that are used for sowing should not have materials that are not needed for the purpose. This contamination can occur in two ways:
  - ❖ Contamination by 'off types' in which within a seed lot of one cultivar another cultivar can be mixed. Such contamination reduces the superiority of the genotype sown and restricts the possibility of using the pasture for further seed production

- A second form of contamination is the inclusion of inert material - chaff, dust, pieces of straw, soil, etc. in the seed lot. The amount of this inert material is measured by the analysis for 'purity'. When determining seeding rates or comparing prices of seed lots it is useful to calculate the pure live seed (**PLS**) content of a seed lot, which is the product of percentage viability and percentage purity.

When determining seeding rates or comparing prices of seed lots it is useful to calculate the pure live seed (**PLS**) content of a seed lot, which is the product of percentage viability and percentage purity.

For example, if the seeding rate required is 100 medium sized seeds per m^2.

And that 1 kg is equivalent to 300,000 seeds in number, then to sow 100 ha grazing land we need to have 333 kg PLS.

Here is the calculation:

$1m^2$ ===> 100 seeds

$1000\ 000m^2$ (100 ha) ===>X

X= 333 kg PLS

If the purity is 80% and germination 70%

From 100 kg - 80 are pure

From 1 kg ===> X

X= 0.8 kg pure seeds

100 ===> 70 germinable

0.8 ===> X

$X = \frac{0.8 \times 70}{100} = 0.49$

0.8kg ===> 0.49 kg PLS

X ===> 333 kg PLS

X = $\frac{0.8 \times 333}{0.49}$ = 544 kg

Therefore, an estimated 544 kg seeds are required to obtain 333 kg PLS.

Another example of using this PLS concept is in comparing prices of seed lots.

Consider two seed lots of P. maximum; lot A is of 90% purity and 60% viability and retails at 8 Birr per kg; lot B is of 80% purity and 40% viability and retails at 5 Birr per kg.

When a comparison is made regarding their price on the PLS concept,

The price per kg PLS for lot A is 8/0.9 x 0.6 = 15 Birr

The price per kg PLS for lot B is 5/0.8 x 0.4 = 16 Birr (more expensive)

- ***Seed longevity*** -Viability is the first criterion of quality. However, the maintenance of this viability for long time periods may be an important consideration for the seed user who stores seed for sowing in a subsequent year. In these circumstances dormant seeds (legume seeds) will maintain viability. The death of seeds is increased by high seed moisture content (which is influenced by the relative humidity of the storage atmosphere), by high temperature, and a high oxygen content of the storage atmosphere.

- ***Seed Vigorousity-*** There is difficulty in defining and measuring this concept of seed vigorousity. Generally it implies that ability to germinate over a wider range of environmental conditions, reliable establishment in the field and higher yields.

- ***Seed dormancy***- This is a natural protective phenomenon which prevents all the seeds of a population from germination on one occasion (hence minimizes risks in uncertain habitats). This allows the prevention of loss of all soil seed reserves serving as an insurance measure in unreliable environments. Dormancy can be embryo dormancy in which the embryos are physiologically inactive, due to inactive enzyme systems. The second type of dormancy is associated with seed coat characteristics. The seed coat may mechanically constrict the expansion and growth of the embryo, prevent the entry of moisture and gases (example legumes), or contain a chemical which inhibits germination (example in Buffel grass, *C. ciliaris*).

4.2. Seed treatment

Seed treatments techniques:-

- ✓ Chemicals
- ✓ Physical
- ✓ 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

Methods of breaking seed dormancy

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

Scarification: 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.

4.3. Seed rates

Seed rate depends primarily on the viability and purity of the seed. Furthermore, seed rate depends on seed size, pure stand or mixture, amount of rainfall the purpose of the crop (herbage or seed), pattern of planting and soil fertility. As a general guideline, for row planting, sow grasses at 6–8 kg/ha, legumes at 3–4 kg/ha, and fodder shrubs at 10–15 kg/ha. When broadcasting seed, sow at double the rate recommended for row planting. The following table illustrates some of the recommended seeding rates.

No.	Forage species	Seed rate
1	Chloris gayana/ Rhodess grass	3-5 kg/ha
2	Callide Rhodes	10 kg/ha
3	Baffle grass	10 kg/ha
4	Trefolium tembensa	5 kg/ha
5	Fodder beet	10 kg/ha
6	Trifolium quartinianum	5 kg/ha
7	Siratrro	4 kg/ha
8	Lablab	20 kg/ha
9	Trueppellianum	5 kg/ha
10	Setaria	10 kg/ha
11	Cow pea/ vigna ungiculata	20 kg/ha
12	Marculatus	6 kg/ha
13	Alfalfa/Medicago sativa	10 kg/ha
14	Green leaf	5 kg/ha
15	Seca	4 kg/ha
16	Medicago truncatula	10 kg/ha
17	Leucaena palide	Seedling
18	Red clover	6 kg/ha
19	Trefolium steudneri	5 kg/ha
20	Verano	6 kg/ha
21	Vetch	20 kg/ha
22	Panicum coloratum	15 kg/ha
23	Tree leucerne	Seedling
24	Tallfescue	15 kg/ha
25	Melilotusalba	10 kg/ha
26	Phalaris acutica	15 kg/ha
27	Oat/avena sativa	10 kg/ha
28	Susbania	Seedling

29	Elephant/Napier grass	Cut & splits

Self-Check -4	**Written Test**

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

1. What are the essential criteria's to select quality seed of forage? (4 points)

List methods of forage seed treatment (3 point)

2. List some grass seeds and its rates of sowing (3 pts.)

Note: Satisfactory rating – 7 points unsatisfactory rating –below 7 points

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions:

1._____

2._____

3._____

Information sheet – 5	Setting Pests, weeds and diseases control methods

5.1. Weed control

Weed reduces the yield of seed by competing for:-

- ✓ Soil moisture
- ✓ Nutrients
- ✓ Sunlight
- ✓ Seed quality by contamination with weed seeds

Production of high quality seed requires a weed free pasture. Grower should never rely on seed cleaning as a means of overcoming weed contamination. Weeds especially broad leaved once can be dangerous, leading to partial or complete failure. Legume seed forage is particularly vulnerable to weed invasion.

Weeds affect seed yields and quality. Efficient weed control reduces contamination with weed seeds during harvesting.

- ➢ Thorough and repeated cultivation, hand weeding, use of herbicides, crop rotations, etc., offer a reasonable degree of weed eradication.
- ➢ Weed control methods are chemical, physical and biological.

5.2. Pest and Disease control

- ➢ Birds are the most damaging pest for grass and seed crops
- ➢ Insect pests including moth caterpillars, sucking bags and butterflies are more severe pests for legumes, often seen feeding on pods and flowers.

- Diseases are generally more severe with legumes than with grasses.
  - ✓ The more important legume diseases are rhizoctonia leaf bright, anthracnose in stylos, and rust on siratro viruses on many species.
  - ✓ Grass suffers mostly from fungal disease like ergots and smuts.
- Pests like mole rats, porcupines, wild herbivores and insect pests can be a threat to pasture seed crops.
- Insect larvae of the Sesbania beetle (*Mesoplatis orchoptera*), for example, can devastate plots of stands overnight.
- Control measures against such serious insect pests could be expensive at an advanced level of infestation and thus prompt spot-spraying at the earliest detection with recommended chemicals is necessary.
- Diseases, especially fungal, are more serious in grasses than in legume seed crops.
- Disease-control measures in forage crops are based on the use of resistant crop varieties and employing pre-emptive cultural practices such as:
  - ❖ crop rotations
  - ❖ burning of infected plants
  - ❖ solar treatment of soil
  - ❖ use of clean and treated seed

Self-Check -5	Written Test

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

1. List ways of forage weed control (4 points)
2. What are pests that affect forage/pasture in your district? (4 points)
3. By what mechanisms disease control taken measures from forage crops? (5 points)

Note: Satisfactory rating – 8 points unsatisfactory rating –below 8 points

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions:

1._____

2._____

3._____

Operation sheet -1	Procedures in forage seed germination test

Techniques to test germination of forage as follows:-

Step 1: Place the blotting paper in the germination tray (shallow dish) and moisten it. Do not wet the paper;

Step 2: Place 100 seeds in the tray, scattering them evenly along the shallow dish;

Step 3: Keep the tray at room temperature;

Step 4: Keep the blotting paper moist all the time

Step 5: Check the seeds once a day and count the germinated ones

Step 6: Continue this for a week

Step 7: Express the number that sprouted on percentage basis

Step 8: Make three replications or repeat it three times

LAP Test	Practical Demonstration

Task. Test seed germination rates of forages

REFERENCE

www.https:// articles. Extension.org. Nutritional requirements of livestock

Duguma Gemeda. 2010. Participatory definition of breeding objectives and implementation of community based sheep breeding programs in Ethiopia. PhD Thesis, University of Natural Resources and Life Sciences, Vienna, Austria.

Muhammad, R. 2016. Elephant grass as forage for ruminant animals. Department of Forage Crops and Grassland Management, Faculty of Animal Science, Hasanuddin University, Indonesia.

Instruction Sheet	Learning Guide # 46

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

- Determining harvesting time and stage
- Storing harvested forage
- Determining utilization of developed forage

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 harvesting time and stage
- store harvested forage
- determine utilization of developed forage

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2 and Sheet 3,
4. Accomplish the “Self-check 1, Self-check t 2 and Self-check 3” **in page - 5, 7 and 14** respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1” **in page - 15.**
6. Do the “LAP test” **in page – 15** (if you are ready).

Information sheet – 1	Determining harvesting time and stage

1.1. Effect of Stage Harvesting on Forage Quality and yield

Pasture quality (irrespective plant species) can be affected by the harvesting days of first date of cut and frequency of harvesting which consequently reduces the nutritive value. As pastures mature they are characterized by high content of fiber with a higher grade of lignification and low protein content. Most improved grasses fed at early stages of maturity are more digestible and are eaten in larger quantities than at more mature stages. Leaf to stem ratio is used as an index of quality, the quality of herbage depends on the proportions of stem and leaf in the particular plant species. Early harvesting had significantly higher leaf to stem ratio as compare late harvesting days. The leaf to stem ratio decreased as the plants advanced in maturity. The presence of an increased proportion of plant stems, typical of older plants, may restrict access to leafy parts and force animals to consume lower quality herbage. Digestibility of stem is much lower than leaf, digestibility of old grass is much lower than young grass while protein content also decreases as the plant ages, particularly in grasses. The aging of forage is frequently associated with a decrease in leafiness and an increase in stem to leaf ratio.

Stage of harvest influence the herbage dry matter yield, crude protein concentration and other chemical constituents. This suggests that there may be a physiological trigger, which leads to the increased production of stem material in tropical pastures. Changes in leaf number are themselves associated with changes in the number of internodes, and thus length of stems. Internodes length of elephant grass increased significantly with increased days of harvesting. Length of internodes per plant was affected significantly by harvesting days. Late harvesting significantly produced longer internodes as compared to early and intermediate harvestings.

Perennial grasses often live for relatively a few or several seasons by succession of secondary tillers, which replace the original tillers. However, annual grasses flower and die without producing replacement tillers which will be the reason for the death of the whole plant. Tiller number per plant of grass increased with increased days of harvesting. The yield and quality of grassland is significantly influenced by harvesting stages of grass.

1.2. Harvesting at the Right Stage of Maturity

Harvesting at the right stage of maturity is one way of enhancing crop residue yield and quality. Early harvesting immediately after physiological maturity of the crop was found to improve the crop residue yield and quality without adverse effects on the grain yield and quality.

Self-Check-1	Written Test

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

1. List conditions that indicate maturity time of forage. (3 points)
2. At what time forage harvested? (4 points)

Note: Satisfactory rating – 3 points unsatisfactory rating –below 3 points

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions:

1._____

2._____

Information sheet – 2	Storing harvested forage

Proper Handling and Storage

Loss of leaves due to shattering, during harvesting, drying, transport, storage, and feeding of cereal crop residues to livestock feeding may be high due to the losses and inefficiencies associated with these operations. Straws and stovers should be stored only after they are dried to moisture content of less than 10-15%. Rain or moisture during harvest of straw can also cause fungal growth or loss of nutrients due to leaching prior to storage. In order to minimize spoilage, straws or Stover's should be stored in well ventilated sheds or in well-staked open heaps. In general, efforts should be made to minimize deterioration of the straw due to shattering of leaves, leaching and microbial attack during storage. Wastage should be minimized during feeding as well. Straws and stovers are offered on a feed trough or on a clean ground to minimize feed wastage due to trampling and soiling with dung.

Hay must be stored in a dry environment. Good quality hay should never be poorly stored. The type of storage may vary from area to area. A good stack of loose or baled hay will provide satisfactory storage in arid areas where there is little rainfall. More expensive shelters may be required for high rainfall areas. It is advisable to store hay by kinds and grades in case variable qualities are stored. Hay can also be stored by creating hay stacks. Stacks may be covered by plastic sheets to keep out rain. The surface layer of a stack may also be "thatched," in the same manner as a thatched roof to a house.

Hay of higher moisture content should not be stored because its nutritive value may be greatly lowered. It is generally the most convenient form of stored fodder and an appropriate forage conservation method for small-scale farmers and pastoralists with limited resources. Proper drying is essential so that the hay can be stored safely without heating excessively or becoming

moldy. Maximum leafiness, green color, nutrient value and palatability can also be retained. The grass should be dried quickly and not unduly exposed to the sun to maintain these characteristics. Hay must be stored in a dry place. Hay can be bailed and stored under cover. Hay can also be store by creating hay stacks or hay store. These may be created in a field near the source, or close to where the hay will be required later in the year. Stacks may be covered by plastic sheets to keep out rains. The surface layer of a stack may also be thatched, in the same manner as a thatched roof to a house.

Self-Check -2	Written Test

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

1. In handling of developed forage, list cause of loss of forage leaves (4 points)
2. Is that possible to store hay without bailing? (5 points)
3. List materials that used for covering and stack making in hay storage (4 points)

Note: Satisfactory rating – 8 points unsatisfactory rating –below 8 points

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions:

1._____

2._____

3._____

Information sheet – 3	Determining utilization of developed forage

Systems of forage utilization fall into **two** major categories:

A. Immediate use

- ✓ Grazing
- ✓ green chop

B. Conserved forage

- ✓ standing hay
- ✓ hay
- ✓ silage

- The objective is to maximize the utilizable yield of the forage crop. In deciding the usage system, one has to consider the following:
- Type and persistence of the forage: Species with persistent and strong root systems are preferred for grazing while fast-regenerating and erect-growing ones are suitable for haying.
- Type of the farm enterprise: e.g., green chop/cut-and-carry systems are suitable for dairying and fattening.
- Potential maximum forage yield versus expected loss in the type of usage: If low herbage yield is expected for some reason, wastage due to conservation must be avoided, e.g., silage has the disadvantage of wastage compared with hay

3.1. Grazing

Grazing is the most common and the cheapest utilization method for both natural and sown pastures. In the case of sown pastures, prior to establishment, species have to be selected for palatability, accessibility, nutritive value and their ability to tiller profusely, resist defoliation and trampling, and respond to fertilization,.

Advantages

- ✓ Effective recycling of nutrients.
- ✓ Possible manipulation of transfer of nutrients from day grazed paddocks to night corrals via manure.
- ✓ Requires less labor and is less time-consuming
- ✓ Animals can select their diet in both quality and quantity.

Limitations of grazing

- ✓ Loss of material due to trampling, fecal contamination.
- ✓ Selective grazing.
- ✓ Early maturity, leading to stemmy stands
- ✓ Difficulty in clay soils, i.e., excessive plant damage and crusting.
- ✓ In some forage species, reduced content of soluble carbohydrates and subsequent production of toxicity of prussic acid (HCN), nitrite, and magnesium tetany is observed on cloudy days.
- ✓ Requires controlled grazing — fencing or shepherding.

Grazing capacity of native pastures

Grazing studies on native pastures at Holetta Research Center indicate that well-managed natural pastures could be stocked at 2 Tropical Livestock Units (TLU)/ha from July to end of December and 10 sheep/ha for year-round grazing with hay supplementation during the dry season. Cutting or grazing at 2-week intervals reduced total dry matter to about 50% of that obtained from a 4-week grazing interval, indicating that a rest period of at least 4 weeks was important.

3.2. Green chop/cut-and-carry system

Green chop is cutting green forage in the field and transporting it to the livestock (also called

cut-and carry system). It is a common practice in areas where grazing land is limited, e.g., traditional feeding of tethered beef cattle in Hararghe (Eastern Ethiopia); thinned maize plants; garden weeds; chat (*Catha edulis*) leftover ('*geraba*'), etc. A cut-and-carry system involving improved forages is more economical for commercial dairy farms and feedlot cattle finishers, and holds advantages for small ruminant feeding as well. When the green chop feeding operation aims to collect animal excreta in a confined space and return it to the land to build soil fertility, it is called *soilage*

Advantages of cut-and-carry system

- ✓ High recovery of plant material as it is not lost by trampling and contamination.
- ✓ Little selectivity because the system allows for rationing of animal intake.
- ✓ Feeding can be arranged at a convenient site.
- ✓ The excreta can be utilized as farm yard manure and applied where it is most required or composted.

Limitations of cut-and-carry system

- ✓ The continued removal of plant material could lead to deficiencies of soil nutrients, particularly potash.
- ✓ Requires high labor for cutting, chopping and transporting

3.1. Standing hay (deferred feed)

Deferred feed is the cheapest and easiest way of conserving forage, as it does not require machinery or physical handling. It is a common traditional practice in rural areas of Ethiopian highlands where certain village communities by common consent defer the bottomland communal grazing lands for use during the dry season. It is also practiced by large ranch holders and pastoralists in the drier areas.

Limitations

- ✓ High risk of fire hazard.
- ✓ Possible occurrence of light rainfall where the culms and leaves become moldy, called "blackening", making the standing hay useless as forage.

3.2. Stored fodder

Storing fodder is an important operation in livestock farming to bridge the gap in feed supply during dry seasons, recurrent drought hazards, and during the cropping season when grazing land becomes scarce. The aim of conserving fodder is to harvest the crop at its maximum nutrient content and minimize losses while at the same time maintaining its acceptability to the animal. The time of harvest may be earlier if higher protein content is required or later if maximum dry matter is desired. Therefore, time of cutting is a compromise between quality and quantity of the harvested forage. Fodder is usually conserved as hay and sometimes as silage especially for dairy business.

3.2.1. Hay

Hay is feed produced by drying green forage to a moisture content of 15% or less. It is the most commonly stored fodder on the farm and used to level-out the feed supply throughout the year. Hay is generally the most convenient processed form of storage and an appropriate forage conservation method for small-scale farming. Well-processed hay is the cheapest form of feed during the non-grazing season. Hay should be made at the optimum date to maximize yield and still fulfill the nutrient needs of the livestock. It is best cut early in the flowering stage. When cut earlier, the nutritive value is higher but yield is lower and the moisture content is too high for easy curing. If cut after flowering, the increased yield does not compensate for decreased palatability and nutritive value. The first cut of hay from a crop is usually of better quality than subsequent cuttings.

Problems in haymaking vary according to the crop, climate and prevailing weather at harvest:

- ✓ Sub-humid and humid conditions:
    - Slowness of drying (the aim is to dry the crop as quickly as conditions will allow to avoid loss by spoilage).
- ✓ Hot, dry conditions:
    - Too rapid drying.
    - Shattering of the finer parts of the plant.

- Bleaching, with consequent loss of carotene and vitamins.

Factors influencing hay quality

- ✓ **Maturity:** Affects both yield and composition of hay.
  - ❖ Young plants are more digestible because they have less structural fiber and lignin, which are difficult to digest.
  - ❖ Young plants are higher in protein, minerals and carotene than older plants
  - ❖ Young plants are more palatable, tender and less fibrous.
- ✓ **Leafiness:** Applies mainly to legume hay.
  - ❖ The percentage of leaves is the best index of actual feed value of alfalfa, clover and other legume hays.
  - ❖ Leaves are higher than stems in protein, fat, ash, nitrogen-free extract, calcium and phosphorus.
  - ❖ Leaves have a higher digestibility than stems.
- ✓ **Color:** Is an indication of maturity, the care exercised in curing, and the amount of weather to which the hay has been exposed.
  - ❖ A high percentage of natural green color (pea-green color) in hay indicates early cutting, good curing, high palatability, freedom from must or mold and high carotene content.
- ✓ **Foreign matter:** Indicates hay of low feeding value.
  - ❖ Injurious foreign matter, such as wire, stones, etc.
  - ❖ Poisonous plants, hard, bearded grasses etc.
- ✓ **Condition:** Refers to soundness of hay. Unsound hay is an indicator of poor quality and low nutrient content.
  - ❖ Contains excess moisture (under-cured).
  - ❖ Heated or hot hay, perhaps a burnt-brown appearance.
  - ❖ Has a musty or sour, rotten odor, generally due to heating.
  - ❖ Moldy.
  - ❖ Lacks the aroma of well-cured hay.

- ✓ **Texture**: Refers to the size of the stems. Texture is influenced by the thickness of the stand, maturity, percent leaves and the rainfall, soil fertility and other environmental conditions affecting the rankness of growth.
- ✓ **Variety**: Refers to kind or variety. Legume hay is more valuable than grass hay of the same maturity condition and foreign-matter content.

3.2.2. Silage

Silage is moist forage that is the product of acid fermentation of green forage crops that have been compressed and stored under anaerobic conditions in a container called a silo. A point of precaution in silage making is that it is not economically justified nor is there a special advantage to be gained in terms of animal nutrition by ensiling forages as long as the weather allows making good quality hay.

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.

Self-Check -3	Written Test

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

1. List methods of utilization of developed forage (4 points)
2. What are the disadvantages of cut and carry system? (3 point)
3. List advantage of making silage (3 points.)

Note: Satisfactory rating – 7 points unsatisfactory rating –below 7 points

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions:

1._____

2._____

3._____

Operation sheet -1	Procedures in harvesting time and stage of forage

Techniques to harvest forage as follows:-

Step 1: prepare materials for mowing

Step 2: mow at early stage

Step 3: mow/cut at dry time/day

Step 4: carryout wilting of harvested forage (if you use as hay)

Step 5: make ready for storage under roof that have cover

Step 6: protect risk factors like fire, pests, etc. from stack hay

Step 7: feed animals

LAP Test	Practical Demonstration

Task1; Determine harvesting time and stage

REFERENCE

Duguma Gemeda. 2010. Participatory definition of breeding objectives and implementation of community based sheep breeding programs in Ethiopia. PhD Thesis, University of Natural Resources and Life Sciences, Vienna, Austria.

Muhammad, R. 2016. Elephant grass as forage for ruminant animals. Department of Forage Crops and Grassland Management, Faculty of Animal Science, Hasanuddin University, Indonesia.

Instruction Sheet	Learning Guide # 47

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

- Returning and disposing materials
- Cleaning, maintaining and storing tools and equipment
- Reporting difficulties in completion and work outcomes

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 –

- return and disposing materials
- clean, maintain and store tools and equipment
- report difficulties in completion and work outcomes

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2 and Sheet 3
4. Accomplish the “Self-check 1, Self-check 2 and Self-check 3” **in page - 5, 8 and 12** respectively.

Information sheet – 1	Returning and disposing materials

All tools and equipment as well as materials and machinery necessary for Pasture Establishment and Preservation of feeds should be handled and transported in safe and appropriate way.

Follow the following principles:

1. If in doubt, take it out.
   - The more cluttered your store area is, the more likely tools and materials will be lost.
2. Avoid placing materials on the floor.
   - Save space by introducing multi-level racks.
3. Provide a home for each material.
   - Allocate a special permanent place and a holder or a container to each tool or work item.
   - The most often used item should be nearest and ergonomically situated.

Handling waste materials produced during work

Proper handling: includes the collection, transport, processing, recycling or disposal of waste materials produced by human activity in order to reduce the negative effect on the environment.

Waste: is unwanted material or substance produced by human activity, which is usually referred to as rubbish, trash, garbage or junk. Plant debris and waste materials produced during supporting Pasture Establishment and Preservation of feeds activities should be identified, separated and stored safely for further processing.

The major waste materials include

- Plant debris,
- litter and broken components,
- plastic,

- Paper-based materials. These may be recycled, re-used, returned to the manufacturer or disposed.

Storing produced waste material during work should be safe from a health and safety point of view, the material should bear clear identification, and should be standardized and reusable. Chemical reaction of the material with the environment (rust is a very common one) should be avoided, as well as leaks and spillages.

There are **two** types of disposing materials such as:-

1. Solid Waste Disposal

Improperly disposed of waste attracts rodents and insects, contaminates water and air, increases fire hazards, creates unpleasant odors and causes the area to look unattractive. Insects will always be with us but we can reduce our exposure to them by taking simple, yet effective steps. Insects require food to live and most require a moist habitat to breed. Many types of solid waste, especially garbage, provide these two items. We are most concerned about flies due to their ability to transmit organisms from an infected source to humans. If solid waste is disposed of properly, the fly will have to search elsewhere for its food and breeding area.

2. Excretal Disposal

There are many different ways to dispose of excrete, and, to be effective, they all should adhere to the following requirements:

- The surface soil should not be contaminated.
- There should be no contamination of ground water that may enter springs or wells.
- Excreta should not be accessible to flies or animals.
- There should be freedom from odors or unsightly conditions.
- The method used should be simple and inexpensive in construction, operation and maintenance.
- The excrete use for agricultural or other uses only after it has been treated.
- In the installation of excrete disposal facilities, a safe distance from water sources should be maintained (at least 30 meters or 96 feet).

Materials will be stored for varying periods of time before an entry control is performed or at different stages of the production process and after completion of work. Stores should be safe from a health and safety point of view, the material should bear clear identification, and should

be standardized and reusable. Chemical reaction of the material with the environment (rust is a very common one) should be avoided, as well as leaks and spillages.

Self-Check-1	Written Test

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

1. List two types of disposing materials in forage development (3 points)
2. List waste materials that produced during forage development. (4 points)
3. Discuss requirements that must be fulfilled during disposing excreta waste (5 points)

Note: Satisfactory rating – 8 points unsatisfactory rating –below 8 points

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions:

1._____

2._____

3._____

Information sheet – 2	Cleaning, maintaining and storing tools and equipment

Tools and equipment's should be properly maintained and kept clean after completion of work and stored at convenient place. When equipment's are not functional it should be get maintenance services.

Maintenance is the preservation or safeguarding of machinery, property & equipment's according to the manufacture's manual so that the service life of machineries & equipment's is prolonged and operate in environment friendly condition.

The importance of maintenance

Maintenance is important to make sure the constant production of high quality of production.
You can take the regular maintenance services from your service supplier.
A regular maintenance service will reduce production losses and increase constant production.

Maintenance Procedure:-

In order to maintain any given machinery one has to know the procedures to be performed during maintenance.

The maintenance process involves:

- Identifying the main parts of machines & equipment's
- Identifying machines & equipment's which need maintenance
- Prepare tools & equipment's needed for maintenance
- Identify OHS, hazards &risks involved during maintenance
- Prepare personal protective equipment's to avoid or minimize those risks

Materials will be stored for varying periods of time before an entry control is performed or at different stages of the production process. Stores should be safe from a health and safety point of view, the material should bear clear identification, and means of transport (e.g. boxes, pallets) should be standardized and reusable. Chemical reaction of the material with the environment (rust is a very common one) should be avoided, as well as leaks and spillages. The respective training of transport and warehouse workers is indispensable. Special precautions have to be taken in the case of hazardous materials.

Materials management, often called logistics, holds the responsibility for the transport of materials in many companies. Transport distances depending on the more or less favorable layouts of plants, number of handlings of a material in successive production stages, means of transport (energy consumption, noise and exhaust emissions, electric fork-lift versus diesel fork-lift) and type of transport containers play an important role in environment-friendly materials management. A relatively new task for materials management is the handling of all kinds of wastes and not just the traditional selling.

Self-Check -2	Written Test

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

1. What is the importance of maintenance of tools and equipment? (5 point)
2. List maintenance process of tools and materials (5 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: _____

Name: _____ Date: _____

Short Answer Questions:

1._____

2._____

Information sheet – 3	Reporting difficulties in completion and work outcomes

Reporting is an integral part of monitoring and evaluation. Reporting is the systematic and timely provision of essential information at periodic intervals. For the Global Fund projects reports are provided on quarterly and annual basis. The quality of organizational decision depends on the quality of information reported and organized. Report should be objectively and timely. Because, report enable managers to evaluate progress and plan the future. Detailed report is precious formal document prepared and presented by the workers to the higher management concerning the works on operation or completed

Report may be defined as a formal statement describing a state of affairs or what has happened. It has detailed description of a problem or a situation, findings of an investigation and recommendations or actions taken. Or we can say that it is submitted by a lower authority to a higher authority and it is a back bone of communication. The quality of organizational decision depends on the quality of information reported and organized. Report should be objectively and timely. Because, report enable managers to evaluate progress and plan the future. Detailed report is precious formal document prepared and presented by the workers to the higher management concerning the works on operation or completed.

The report may contain the following.

- The report that represents the result of technical, economic and financial feasibility of the program or project.
- Report serves as the basis on the basis of which the concerned government body gives clearance /sanction of the planned works.

- Report serves as guide for the starting and implementation of the planned activities.
- Report is helpful in achieving the time and cost limits in the completion of the planned activities.
- Report is helpful in obtaining technical and financial assistance from different cooperative organizations and bodies.
- Report reflects commitment of the organization /group of the planned work performers.

Report includes:-

- General information about the work
- Background of the participants of the work
- Details of the work or project Capacity
- Process Technical arrangement
- Raw materials and tools
- Schedule of implementation
- Attitude of beneficiaries
- Participation of stakeholders
- Cost estimated and used
- Means of finance
- Cash flow details
- Economic consideration
- Local, regional and federal government clearance.

Types of Reports

Reports could be oral or written. On which oral report is face to face communication which is informal and time saving. On the other hand, written report is formal and relatively more accurate and precise. On the basis of format and procedure; adopted reports may be formal or informal.

- **Informal report** is report of person to person communication where as

- **Formal report** is presented in prescribed form and procedures.

Characteristics of Good Report

- Simplicity: - simple and lucid language
- Clarity: - proper arrangement of facts
- Accuracy: - unbiased information
- Precision: - conciseness or coherence
- Completeness: - complete in all respect
- Relevance: - to the purpose it prepared
- Cross-reference:- making and mentioning
- Objectivity: - impartial and free from prejudice
- Brevity: - brief without being incomplete
- Reader oriented: - for specialist is not appropriate for layman

Steps in Report Writing

Step one:-collect the material (notes, documents etc.)

Step two:-Plan the report

- Define purpose of report
- Determine the information it should contain
- Arrange the information in a logical order
- Prepare an outline of the report subject:
- Decide where illustrations of diagrams are required

Step 3:- Draft the report

- Introduction/purpose, reading, summery,
- Body of the report
- Conclusions and recommendations

Step four:-edit the report

- Examine the draft (serve the purpose)

- Check grammar, spelling, punctuation etc.
- Check illustrations,

Step five: - Reporting to the concerned body

- *Formats of Report Writing*
- Date and title
- Introduction
- Body of report (planned, implemented and how is implanted)
- Conclusions and recommendations
- Contribution of every involved body in the implementation of the plan
- Challenges and solutions for the challenges
- Signature
- Appendices

Self-Check -3	Written Test

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

1. What are the characteristics of report writing? (3 points)
2. List steps in report writing (5 points)
3. Mention types of report. (4 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: _____

Name: _____ Date: _____

Short Answer Questions:

1._____

2._____

3._____

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