ANIMAL PRODUCTION

Level –IV

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

Module Title: Facilitating Rangeland Development and Management

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

Table of Contents

LG # 44	LO1. Identify rangeland values

Instruction sheet

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

- Determining characteristics of rangeland environment
- Analyzing the importance of range land
- Assessing the Nutritive value of range land

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 characteristics of rangeland environment
- Analyze the importance of range land
- Assess the Nutritive value of range land

Learning Instructions:

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

Information sheet 1- Determining Characteristics of rangeland environment

1.1. Introduction

Rangelands are a kind of land dominated by specific types of vegetation, and NOT a type of land use. They include "land on which the indigenous vegetation (climax or natural potential) is predominantly grasses, grass-like plants, forbs, or shrubs and is managed as a natural ecosystem. Rangelands include grasslands, savannas, shrub lands, many deserts, arctic tundra, mountain alpine communities, marshes and meadows. The environment is often dominated by an arid or semi-arid moisture regime. However, some grasslands and marshes occur in more mesic environments.

Rangelands are distinguished from pasture lands because they grow primarily native vegetation, rather than plants established by humans. Rangelands are also managed principally with extensive practices such as managed livestock grazing and prescribed fire rather than more intensive agricultural practices of seeding, irrigation, and the use of fertilizers.

Grazing is an important use of rangelands but the term "rangeland" is not synonymous with "grazinglands". There are areas of rangeland that are not grazed and there are grazed areas that are not rangelands. Livestock grazing can be used to manage rangelands by harvesting forage to produce livestock, changing plant composition or reducing fuel loads.

Important Terminologies

Rangeland: Land on which the native vegetation (climax or natural potential plant community) is predominantly grasses, grass-like plants, forbs, shrubs, suitable for grazing or browsing use.

Rangeland: is a type of land that supports different vegetation types including scrublands such as deserts and chaparral, grasslands, steppes, woodlands, temporarily treeless areas in forest and wherever dry sandy, rocky saline, or wet soil, and steep topography preclude the growing of commercial farm and timber crops *(heady and child, 1994:US).*

Grassland: Any plant community in which grasses and/or legumes compose the dominant vegetation.

Shrub: A perennial woody plant smaller than a tree and having several stems arising at a point

near the ground.

Pasture: A fenced area of land covered with grass or other herbaceous forage plants, with application of agronomic activities, and used for grazing animals.

Pasturage: Vegetation on which animals graze, including grasses or grass like plants, legumes, forbs, and shrubs.

Range sciences: the organized body of knowledge upon which range management is based

Ecology: involves the study of interrelationships between organisms and their environment

Ecosystem: a "functional unit consisting of organisms (including man) and environmental variables of a specific area. It is an area with similar ecological characteristics on which man has placed boundaries for management purposes.

Rangeland ecosystem: a piece of rangeland comprising of living and nonliving elements on which man has placed boundaries for management purposes

Range management: The science of maintaining of maximum range forage production without jeopardy to other resources or uses of the land.

It is the science and art of optimizing the returns from rangelands in those combination most desired by suitable to society through manipulation of range ecosystem.

It is the manipulation of rangeland components to obtain the optimum combination of goods and services for society on sustainable bases.

Range Manger: job is to minimize energy and nutrients wastage at any food web of a given ecosystem and maximize system health.

Carrying capacity

Number of animals a given pasture will safely support at a specified level of animal gain or production for a given period of time (or the number of animals, which can be safely sustained for a given period of time), i.e. it is the optimum stocking rate

Over grazing:

Defined as repeated heavy grazing those results in deterioration of the plant community. The grazing of a number of animals on a given area that if continued to the end of the planned grazing period, will result in less than satisfactory pasture forage production. Caution must be taken when declaring a range as "overgrazed" because it is difficult of truly assessing whether land is "overgrazed." Pastures can be heavily grazed but that may not lead to land degradation.

Stocking rate: is the actual number of animals or animal units on a unit of land for a specific period of time, usually for a grazing season.

Over stocking: The placing of a number of animals on a given area that will result in overuse if continued to the end of the planned grazing period. Continued overstocking will lead to over grazing.

Stocking density: The relationship between number of animals and area of land at any instant of time. It differs from stocking rate which expresses animal to land allotment for the entire grazing season. A high stocking density often requires a short grazing period and it is used to attain full forage utilization before re growth can be grazed.

Grazing pressure: The amount of forage allowed per animal of specified kind and physiological condition at a specific time, or, conversely, the number of animals per unit available forage.

Instantaneous stocking rates (stocking density): The relationship b/n number of animals and area of land at any instant of time. (a.u.ha)

Sustained stocking rate: The number of animals growing a unit of area for the entire grazing period ($a.u.ha^{-1}$ $Time^{-1}$ usually 1year)

Animal unit (AU): considered to be one mature (450 kg or 1000lb.) cow or the equivalent based on average daily forage consumption of 10 kg dry matter per day.

Animal production ha^{-1} =production $head^{-1}$ x No.animals ha^{-1}

Herbage allowance: the weight of herbage (dry or ash-free) per unit of animal live weight at a point in time.

Defoliation is used to mean removal of plant parts by grazing or cutting.

1.2. General characteristics of rangelands

The environment of rangelands are the basic determinant of the nature and productivity of the range ecosystem, which is characterized by highly variable physical, environmental factors like climate, topography and soil that determine the potential of range areas to support definite types and level of land use. Rangelands characterized by a cause of physical limitations like low and erratic precipitation, rough topography poor drainage, hot or cold temperature, high salinity, arid and semi arid agro-ecology, harsh environment etc. and also characterized by extremely seasonal conditions, with relatively low rainfall, very long dry season, humidity is also low, not suitable for agronomic activities, used for grazing and unstable.

- Unimproved and /or native plants
- Predominantly grasses
- Includes naturally re-vegetated forage
- Multiple-use: grazing, nature conservation, dwelling, recreation, mining, etc.
- Wild and domestic livestock
- 65% of world land cover is rangeland

Rangelands are vast expanses of uncultivable land where normal crop production is not possible (or not economical) this could be due to one or more of the following environmental limitations.

A. **Unfavorable climate**: particularly erratic rainfall. Most rangelands receive total annual rainfall below 500 mm, or even as low as 200-350 mm.

B, **Poor soil**:

- Roughness, stone outcrop
- Very thin soil horizon
- Poor fertility
- Excessive mineral accumulation. (E.g. carbonates, sulphates, fluorides)

C. **Topographic / landscape limitations**

- Furrow (gully), Slopping, Water logged

Such lands are typically referred to as marginal lands.

The best alternative of utilizing such wastelands in terms of agriculture is usually as rangelands for multiple benefits of:

- Livestock production, especially beef or mohair commodities
- Game animal sanctuary / recreation / tourism
- Watershed, Conservation of biodiversity

Self-Check -1	Written Test

Directions: Answer all the questions listed below.

1. Mention the environmental limitations of Rangelands where normal crop production is not possible (or not economical) (3 points)
2. What is the difference between grass land and range land? (3 points)
3. reason out why the term "rangeland" is not synonymous with "grazing lands" even though Grazing is an important use of rangelands (5 points)

Note: **Satisfactory rating – 11 points** **Unsatisfactory - below 11 points**

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

Information sheet 2- Analyzing the importance of range land

2.1. Introduction

In many developing countries where range lands are a dominant land type and critically important in livelihood of a significant portion of the populations, sever range land degradation and/or conflicts over range land use can create significant social, economic and environmental problems. Despite this fact it has several advantages.

2.2. Importance of range land

2.2.1 Socio economic importance of rangelands

- Throughout the world, rangelands are the major sources of feed for both domestic and wild ruminant animals.
- In most developing African and South American countries, rangelands provide over 85% of the total feed needs of domestic ruminants
- On worldwide basis, rangelands contribute about 70% of the feed needs of domestic ruminants.

2.2.2 Production of animal products

- Range land plays a major role in supplying human population with animal products in all the land regions of the world.
- In Ethiopia, the range land livestock production system, takes the form of pastoralism and agro-pastoralism in the arid and semi-arid agro ecologies respectively.
- Largely depend on livestock rearing for their livelihood.
- In these agro-ecologies, crop production is extremely risky.
- Livestock can use vegetation that would otherwise be wasted, and convert it to valuable, high quality products such as meat, milk, hides and skins etc.
- Share of pastoral and agro-pastoral areas in terms of livestock ownership is 28% for cattle, 26% for sheep, 66% for goats and 100% for camels. According to this estimate, the lowlands carry about 26% of the total livestock population of Ethiopia.

2.2.3 Wildlife

- Rangelands are the primary habitat for nearly all the land-dwelling wild animals highly valued for meat, hunting and aesthetic viewing.

- In certain African countries, such as Kenya, income from tourists viewing wildlife is of crucial importance to the national economy.
- Rangeland wildlife has potential as a source of meat for human consumption in many African countries.
- In more specific terms, the country as a whole has 277 species of mammals out of which 31 are endemic and 861 species of birds out of which 24 are endemic
- Out of the 24 endemic bird species, the lowlands share 19 species with the highlands
- In Ethiopia there are different national parks, sanctuaries and reserve areas covering about a total of 25000 km2 located in the dry lands.
- Apart from the Bale and Simen Mountains National Parks the rest are situated in the lowlands
- Rangelands of Ethiopia, a considerable base of an expanded Eco-tourism.

2.2.4. Water

- Most parts of Ethiopia are endowed with an enormous potential for water re-sources development, both surface and ground water.
- The arid, semi-arid and dry sub-humid areas have substantive amounts of water resource.
- Accordingly to the study made by the Ethiopian Institute of Geological Survey (EIGS), the country is classified into five main water resource regions and of these three regions are found in the low lands (dry land areas)

2.2.5. Recreational products

- To engage in outdoor recreational pursuits, hiking, camping, trail biking, picnicking, hunting and fishing are some of the important recreational uses of rangeland.
- Marketable recreational products include hunting, fishing and camping privileges; horseback riding.

2.2.6. Plant products

- Rangelands produce a wide variety of plants that could be very important in meeting our future needs.

- For example, Ogaden region is one of the richest areas considered for endemic flora, characterized by a high diversity in *Acacia*, *Baswellia* and *Commiphora* species.

2.3. Range land vis-à-vis improved pasture and other disciplines

A. Natural pasture (rangeland**)**

- Uncultivated (virgin)
- Mainly native species
- All kind of vegetation (grasses, legumes, shrubs, trees etc)
- Many species
- Low% legume
- Extensive (no irrigation, no fertilizer)
- Short growing season
- Low DM yield, nutritive value, low intake
- Low protein yield and digestibility
- High fiber
- Reduced palatability
- Only grazing /browsing
- Mostly in tropical region

B. Improved pasture

- Sown (cultivated)
- Improved and native species
- Grasses and legumes
- High % of legumes
- Intensive management (labour, forage seed, fertilizer. Fire etc)
- Often fertilizer
- Sometimes irrigation
- Relatively long growing season

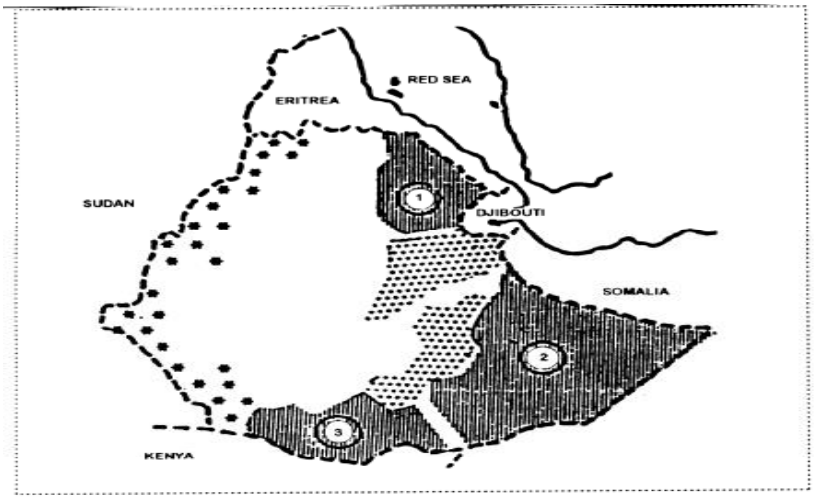
2.4. Location and features of the Ethiopian rangelands

There are three recognized rangelands that have been subjected to rangeland development programs.

a) The Southern Rangelands (Negele Borana Rangelands)

b) The South-eastern Rangelands (Jijiga Rangeland)

c) The North-eastern Rangeland (Lower Awash / Afar Rangeland)



✱✱✱ Limited pastoral use due to trypanosomiasis

●●●● Predominantly pastoral but without large scale pastoral development

||||||||| Predominantly pastoral including large scale development programmes

1. NERDU (Northeastern Rangelands Development Unit)
2. SERP (Southeastern Rangelands Project)
3. SORDU (Southern Rangelands Development Unit)

2.5. Common features of these rangelands

1. All of the rangelands are located in drier parts of the country, i.e., the Rift Valley and adjoining lowlands.
2. They are arid or semi-arid, receiving generally below 600 mm annual rainfall
3. They share the same vegetation zone: the ‘’Somali-Massai *Acacia / Commiphora* woodland and bush land’’, which is an extensive vegetation covering the Eastern and South-eastern African regions.
4. They consist of arid soils (*Aridosols*), which are generally poor in fertility and usually contain excessive salts (saline-sodic soils).

5. In topography, they are usually low-lying plains below 1000 m altitude, with hot weather conditions. Thus, they are less favoured for urbanization.
6. Occupation of the people is predominantly nomadic and semi-nomadic pastoralist.

Self-Check -2	Written Test

Directions: Answer all the questions listed below.

1. Mention the importance of range land (4pts)
2. Compare and contrast the difference between natural pasture(range land) and improved pasture in feeding of animals.(6pts)

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

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

Information sheet 3- Assessing the Nutritive value of range land

3.1. Introduction

Information on different rangeland plants' nutritive values at various growth stages is important in rangelands management. This information helps rangeland managers to choose proper grazing times to achieve higher animal performance without detrimental effects on the rangeland vegetation's. Effects of various plant parts' growth stages and vegetation types on reserve carbohydrates and forage quality indicators were investigated. Results of different studies showed that plants at the seedling stage had more reserve carbohydrates and from the three vegetation types (grass, forbs, and shrub), forbs contained more soluble carbohydrates as compared to the other two (grasses and shrubs).
The improper utilization of rangelands has resulted in great changes in their ecosystem. The more palatable grass species are becoming extinct and are replaced by less palatable weeds. There is a handsome share of various grass species to the feeding regimens of animals during scarcity periods. For prolonged winter scarcity, the grasses are harvested from protected hillside rangelands and stored as hay. Grasses from fertile cropland sides and adjacent uneven areas are also cut several times during summer and are fed to livestock. Free rangeland grasses are, however, still the main way of procuring feed. Nutritive value of locally available free rangeland grass species have never been explored.

3.2. Nutritional Value of Range Forage

The nutrient value of rangeland forages depends upon their ability to meet the grazing animal's nutritional requirements throughout the year. Livestock (or any animal) are a production unit, and each unit has different nutrient requirements based upon its physiological status (yearling steer, cow-calf pair, pregnant cow, dry cow, etc.). Plant nutritional values should be compared with the corresponding animal requirements for the animal's physiological status. The nutrient evaluation of rangeland forage is based upon the plant's content of protein, phosphorus, energy, and carotene (vitamin A). These four principal nutrients are those mostly likely to be deficient in rangeland forage, although localized deficiencies of other nutrients or minerals are possible.

3.2.1. Protein is calculated from the amount of nitrogen contained in plants. Grasses decline in digestible protein rapidly as they mature. Nitrogen is moved by the grass plant from above-ground parts available to the grazing animal to storage organs below the ground as the current year's grass growth matures. Shrubs, on the other hand, are good sources of protein even after they reach full maturity because nutrients remain in branches and leaves as well as below ground. Forbs, in general, are intermediate between shrubs and grasses with respect to protein content during most seasons.

3.2.2. Phosphorus, a macro-mineral, is often limiting in range forage plants. Grasses are low in phosphorus soon after they form seed. Shrubs are generally considered good sources of phosphorus for general animal maintenance and gestation, even when mature. Most forbs have a phosphorus content only slightly lower than that of shrubs. Phosphorus content of plants can fluctuate depending on the soil status. Soils high in phosphorus will allow plants to contain more phosphorus than where soils are limiting in phosphorus content.

3.2.3. Energy values of forage are commonly reported as total digestible nutrients (TDN) or digestible energy (DE). Grasses are generally considered good sources of energy primarily because of their high content of cellulose. In very mature grasses however, digestibility will be so low as to reduce intake and thereby reduce total energy intake. Digestibility is the proportion of a dietary nutrient available for animal metabolism and indirectly tells us something about intake (as digestibility goes down, intake may go down). Shrubs are not considered good sources of energy after they reach fruit development. Again, forbs are intermediate between grasses and shrubs in furnishing energy.

The single biggest problem however, especially when forage plants are mature, is maintaining intake so that the animal gets enough total nutrients each day. Other factors may also affect the nutritive value of range plants. Range condition, for example, may alter total forage intake of grazing cattle. Research shows that protein and phosphorus are about the same in plants growing on good- versus poor-condition range. However, plant species on poor-condition range may be less digestible than plant species on good-condition range, which can reduce total forage intake by grazing animals. The animals either can't or won't eat enough. An appropriate mix of grasses, shrubs, and forbs, is necessary to provide nutritious forage to livestock on a yearlong basis.

3.3. Classification of Range Forage Value: to facilitate management, range plants are commonly classified according to their forage value.

- High forage value

  Designates plants that are nutritious, palatable, and produce abundant forage.

- Medium forage value

  Denotes a plant that will provide adequate nutrients if eaten; however, it is not preferred by animals or does not produce abundant forage.

- Low or poor forage value describes

  Plants that simply do not provide adequate nutrients to the grazing animal. Additionally, most plants containing anti-quality compounds that reduce intake or poisonous plants co taining toxins that cause illness or death in herbivores are classified as having "low" forage value.

3.4. Ways to Manage range Forage: Value Management factors such as stocking rate and specialized grazing systems can also influence grazing animal nutrition. Heavy stocking reduces individual animal performance and can result in damage to the forage resource. Although the influence of animal numbers can be altered by controlling the time the plants are exposed to grazing and allowing for adequate recovery periods, proper stocking rates are essential to long-term rangeland health and healthy, productive grazing animals. Grazing systems may reduce or improve forage nutritive value. Although forage reserves are a necessary part of ranch planning, and some amount of plant material should be left for resource protection, animal production may suffer if pastures are allowed to accumulate too much old plant growth. This can be offset by adjustments in stocking rates or changes in range condition. Carefully planned grazing can help increase diet quality. In grazing cells, for example, the longer animals stay in a particular paddock, the further diet quality is reduced.

3.5. Seasonal changes in forage quality and quantity

Forage quality and quantity are both important to maintaining livestock and wildlife production. Quality and quantity both change substantially throughout the year, and it is important to understand how to balance these attributes. Supplementation programs should be designed to specifically address a deficiency in quality or a lack of quantity to be effective.

2.5.1. Forage Quantity

Forage quantity can be limiting even when there appears to be plenty of available standing crop. This occurs because herbivores have very definite forage preferences and dietary requirements. For forage quantity to be adequate, there has to be sufficient quantity of the preferred plant species for the specific herbivore and sufficient forage of acceptable quality. For example, forage quantity can be a problem in the spring when the quality of the forage is high, but the availability of the green plant material is limited. Drought conditions and overgrazing are the most common causes of insufficient forage quantity.

3.5.2. Forage Quality

Forage quality can be affected by a variety of biological and environmental factors. In general, the nutritional value of forages is highest when the plant has an abundance of young, actively growing leaves and declines as the plant nears maturity. Understanding how and why forage quality changes throughout the year can help producers match the nutritional requirements of their livestock — or wildlife managers matching vegetation to the wildlife species — to the nutrient content of the forage resource. This permits producers to target forage supplementation to the specific needs of their livestock, which should reduce supplementation costs.

Self-Check -3	Written Test

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

1. Mention the common range plants classification according to their forage value. (3 points)
2. list the four principal nutrients most likely to be deficient in rangeland forage (4 points)

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

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

Instruction sheet	
LG # 45	**LO2. Facilitate rangeland development and management program**

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

- Implementing rangeland development program and monitoring carrying capacity and stocking density
- Carrying out strategic grazing
- Introducing and implementing processes to minimize waste and soil degradation.
- Applying principle of rangeland management

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 –**

- Implement rangeland development program and monitoring carrying capacity and stocking density
- Carry out strategic grazing
- Introduce and implement processes to minimize waste and soil degradation.
- Apply principle of rangeland management

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
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6. If you earned a satisfactory evaluation proceed to “Operation sheets

Information sheet 1- Implementing rangeland development program and monitoring carrying capacity and stocking density

1.1. Current status of rangelands in Ethiopia

They are characterized by semi-arid to arid climatic conditions with high temperatures and low unreliable and erratic rainfall. The vegetation is composed of graminoids, forbs, and woody plant species. There are also bare lands as part of the range cover. The vegetation cover of the rangelands is in good condition (20%), fair (30%), poor (40%) and the remaining 10% is in much-depleted conditions.

The condition of rangelands in Ethiopia that the natural pastures are poorly managed throughout the country resulting in serious land degradation, reduced biodiversity, gradual decline in nutritive value and replacement by poorly palatable, drought tolerant species. Encroachments by weeds and undesirable woody plants have been threatening the pastoral production system in the Horn of Africa, particularly in Eastern Ethiopia.

Ethiopian rangelands are under the threat of herbaceous and woody plants invasion. Herbaceous weedy species like Xanthium spp. and Parthenium hysterophorus, woody species like Prosopis juliflora, Acacia mellifera, A. senegal. A. nubica and succulents like Opuntia spp. are increasing. They are responsible for a significant reduction in production of the potential of the rangelands. Increasing deforestation, recurrent droughts and over-grazing might have caused the deterioration of the rangeland vegetation, thereby weakening the grazing and browsing capacities of the rangelands. At present, most of the rangelands in the Ethiopia are invaded by noxious weeds, one of which that aggressively invaded the rangeland is P. hysterophorus. The rapid destruction of natural habitats, now occurring at an alarming rate also threatens biological diversity in most areas of the country in general and Jijiga rangeland in particular. Range degradation and vegetation change has been associated with over grazing or climatic variability.

Rangeland degradation was the most serious challenge for pastoral livelihoods in the study area. Major reductions in the quantity and nutritional quality of the vegetation available for grazing in the rangelands resulted from rangeland degradation. Generally the accelerating

course of rangeland degradation showed various features: Deterioration in the quantity, quality and persistence of native pastures (associated with low plant cover, invasion by shrubs of low nutritive value), structural change in the plant cover, notably the loss of palatable grasses and legumes and changes in soil surface conditions, notably compaction through trampling by livestock leading to deterioration in soil-plant-water relationships and reduced germination rate, particularly of the palatable plants.

1.2. Pastoralism in Ethiopia

Ethiopia is a tropical African country, located between 3ºE and 18ºN, with a total land area of approximately 1.1 million km^2. It is strategically located in the Horn of Africa and borders Eritrea in the north and northeast, the Sudan in the northwest and southwest, the Somali and Djibouti republics in the east and the Kenya republic in the south. The topography ranges from 100 m.b.s.l in the northeast of the country known as Dalol depression, where the great African Rift valley starts and then continues to Lake Victoria.

The maximum altitude is recorded at the Ras Dashen mountain with 4620 m.a.s.l (EMSA, 2004), which is registered as a world heritage site by the United Nations. Ras Dashen further bridges the Central Highlands that stretch up to the eastern lowlands of the country. The agro-ecology of Ethiopia is quite diverse and varies from arid tropics, where the annual precipitation is below 200 mm in the lowlands and above 1 400 mm in the humid tropics. Likewise, the dry lands of Ethiopia are mainly characterized by arid, semi-arid and dry humid agro-ecologies.

Pastoral production systems (pastoralism) represent the largest land use system of the agricultural sector, and are based on mobile rangeland livestock production systems. Accordingly, the rangelands of Ethiopia are mainly located within the arid and semi-arid agro-ecological regions below 1 500 m.a.s.l, covering about 62% (682 000 km2) of the total land area of Ethiopia.

The dry lands of Ethiopia are dominated by rangeland based livestock production systems known as pastoralism and agro-pastoralism (partly involved in opportunistic cropping) and represent a significant sector of the national agriculture in the country. For example, pastoralists represent approximately 37% (26.6 million) of the national population that include an

estimated 12.24 million (17%) mobile pastoralists and 14.4 million (20%) agro-pastoralists. Mobile pastoralism is dominant in the arid and semi-arid areas in the eastern, northeastern and southeastern parts of the country, while agro-pastoralism represents an increasing practice in the semi-arid areas in the northwestern, southern and eastern parts of the country. In general, they represent the major pastoral constituency in the Horn of Africa.

The pastoral and agro-pastoral production system also represent approximately 45-55% of the cattle, 75% of the small ruminants, 20% of the equines and 100% of the camels of the total national livestock population. Accordingly, they contribute about 50% to the national agricultural Gross Domestic Product (GDP) and 90% of the annual hard currency earnings from live animal exports (EARO, 2002). The main mobile pastoralists in Ethiopia are the Somalis (Somali region) in the east, the Afars (Afar region) in the northeast, the Oromos (Oromiya region) in the south and south-east and the Southern Omo people (Southern region) in the south and partly in the Gambela and Benshangul regions and around the Dire Dawa Administration

1.2. Vegetation types of Ethiopia

1. **Dry savanna**
   - Semi-arid lowland savanna
   - Altitude 800 - 1500 m.a.s.l.
   - Continuous, dense and tall grass
   - Shrubs and scattered small trees (itan shrub)
   - Location: NW gonder, parts of western welega and ilubador, southern kefa, Sidamo, Gamo Gofa and Parts of Lake Region of the Rift Valley
2. T**horn savanna**
   - Semi-arid lowland, Altitude < 1000 m, Annual and perennial grasses
   - Scattered small shrubs and low acacia
   - Location: most of the Ogaden, southern Borana, lowlands of Bale, Lower Omo valley
3. **Semi-desert**
   - Arid lowland, Altitude < 1000 m, Annual grasses
   - Small herbs and shrubs

- Location: southern Danakil, lower Awash valley, sandy districts of Ogaden < 1000 m

4. Desert

- Very arid, Altitude < 800 m
- Small and scattered plants in lowland steppe
- Location: salt plain and central lowlands of danakil

5. Open deciduous woodland

- Semi-arid to semi-humid lowland woodlands
- Altitude 700 - 1600 m
- Broad-leaved deciduous thickets
- Parts: acacia and euphorbia thickets
- Parts: bamboo thickets
- Location: escarpments of the highlands in the west

6. Bush formations/low woods

- Semi-humid lowland thickets and woodlands
- Altitude: 1500 - 1800
- Mainly broad evergreen thickets
- Partly acacia forest
- Location: escarpments of the highlands s-w and s-e highlands

7. Dry mountain forest

- Semi-humid, Altitude: 1700 - 2600
- Mixed hardwood and coniferous forest
- Conifers high altitude podocarpus (zigba, birbira)
- Conifers low altitude juniperus (tid, gatera)
- Location: mainly southern and south-western highlands

8. Wet evergreen forest

- Humid. Altitude: 1600 - 2200
- Broad-leaved highland forest
- Main spp. Hardwoods
- Location: south-west

9. Mountain savanna

- Semi-humid to humid highland, 2400 - 3400
- Thickets and woodlands, but mostly deforested

10**. High altitude**

- Semi-humid, Altitude: > 3000 m
- Grass and shrub steppes

11. **Mangrove**

- tropical maritime tree

12. **Swamp**

- Lower lying water logging areas
- No trees
- Also 'dry' lakes
- Location: along read sea coast, lakes of rift valley, many other areas

1.3. Carrying capacity:

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

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

1.4. Determining the optimum stoking rate

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

Optimum Stocking Rate = Carrying Capacity

T**he number of animals an enterprise can carry will be influenced primarily by:**

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

Critical information for decision-making about carrying capacity includes:

- Annual pasture growth rate curve and variation across the farm
- Likely variability in pasture growth curves over time based on historical weather data

- Metabolisable energy value of the pasture when plant growth stage changes
- Energy requirements for each class of livestock at each physiological state
- Minimum energy content of grass that will meet the energy requirement for each class of livestock
- Management strategies applied to the breeding herd (timing of calving and weaning, culling strategies, selling ages)
- Fodder conservation and supplementation strategy.

There are six main factors influencing optimum stocking rate.

1. The rate of forage growth

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

2. Accessibility of forage to animals

This may be limited by

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

3. The nutritive value of pasture

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

4. Botanical composition and ground cover

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

- favor shade intolerant species
- cause invasion of weed
- cause erosion hazard

5. Seasonal variation in feed supply

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

1. the period of lower feed supply
2. the amount of surplus feed for conservation

6. Nature of animal product

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

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

Self-Check -1	Written Test

Directions: Answer all the questions listed below.

2. Mention the importance of back yard forage development (2pts)

3. Mention the two categories and key strategies used in forage development program (5pts)

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

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

Information sheet 2- Carrying out strategic grazing

2.1. Introduction

Grazing management is the planning, implementation and monitoring of animal grazing to achieve sustained animal, plant, and land, environmental and economic results under a range of environmental conditions. Grazing management practices seek to optimize livestock production and maintain productive grasslands by minimizing overgrazing, improving forage production and increasing plant and animal diversity. Grazing, when well-managed, allows healthy grasslands to be sustained, livestock operations to meet economic requirements and other plants and animals to flourish. Well-managed grazing techniques can reverse damage and help to restore grassland health.

2.2. Grazing management strategies

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

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

Grazing strategy is a plan for accomplishing a set of objectives based on compressive knowledge of available resources and production and marketing environment. Management can be greatly simplified when grazing strategies are based on clearly stated and prioritized resource management and livestock production objectives Fig.1 below. Decision on when and how to use plant resources have profound effects on the success of grazing strategies. Plant resources can be used for livestock production or wildlife cover and ecosystem functions such as hydrologic condition and site stability.

2.3. Monitoring rangeland conditions

Change in rangeland conditions refers to the alteration or shift in vegetation structure, species (floristic) composition, basal cover and biomass production. These changes occur due to anthropogenic (human) activities and natural factors including grazing practices, manipulation in species mix, soil erosion, uncontrolled bush fire, drought, heat waves, pests and diseases.

2.4. What does rangeland condition monitoring entails?

The monitoring of the rangeland condition is the process of describing, evaluating and recording the state of the rangeland management unit. The complexity and sophistication of the rangeland monitoring programme is subject to the availability of technical skills, time and cost. These circumstances also affect the rangeland monitoring design and the rangeland attributes measured. As much as possible, rangeland condition monitoring techniques have to be simple and easy to apply.

2.5. Practical rangeland condition monitoring techniques

Systematic and simple monitoring techniques help rangeland users to appraise the rangeland condition and make an informed decision on follow-up actions. For practical purpose, the rangeland condition monitoring exercise centres around few key species and the states of the soil condition.

2.6. Best Management Practices

Decisions on when and where to graze planet resources should be based on clearly defined animal production and resource management.

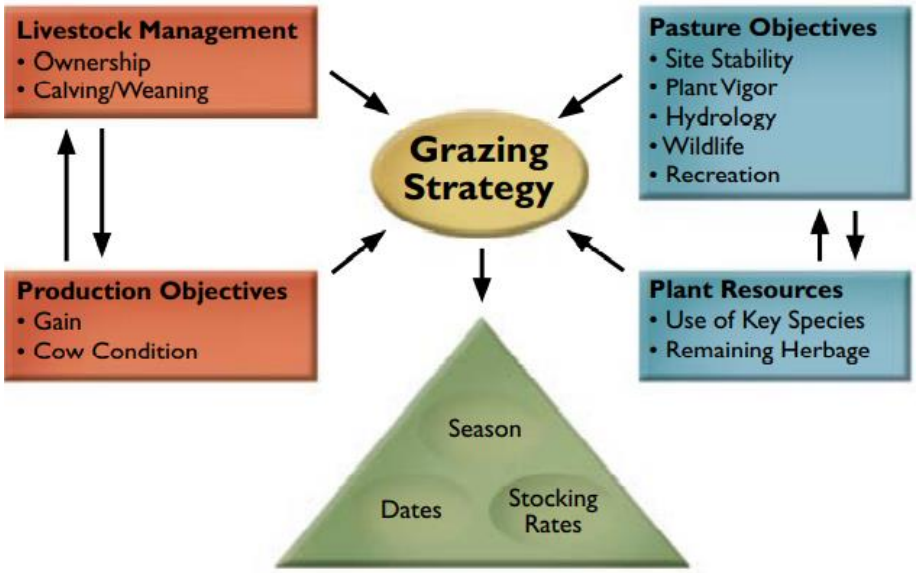

Figure 1. *Grazing strategies should be based on prioritized livestock-production and natural resource-management objectives. These overall plans provide clear guidelines for herbage allocation and selection of an efficient grazing system.*

Figure 1. Grazing strategy

2.7. Range land grazing strategy

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

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

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

Grazing management should: balance livestock demand with forage availability, promote rapid pasture regrowth during the grazing season and promote long-term pasture persistence. The art of grazing management is to ensure that there is sufficient pasture in a stage suitable to graze at all times throughout the grazing season. Several grazing management systems define different methods of harvesting the forage.

2.8. Basic grazing systems:

A. Continuous grazing

It is defined as the type of management whereby grazing animals are confined within a single enclosed pasture area for the entire grazing season it may be a full a year. It is an extensive system of grazing in which the stock remains on the same pasture area for prolonged periods of time. Within this system the pasture may be set stocked or variable stocked.

- Stocking rate should be low
- A normal practice on rangelands and tropical savannah
- Under grazed during the rains and overgrazed during the dry season
- The disadvantages are buildup of tick and nematode infestation and lack of grazing distribution

B. Soiling or zero grazing*:*

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

Advantage:

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

Disadvantage:

- High cost for labor or machinery

- Bedding required for housed stock
- Manure disposal is laborious

C. Rotational grazing:

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

D. Deferred grazing

This i**s** the setting aside of certain pasture paddock for use at later stage e.g. Standing hay Deferment, early season non grazing |delayed grazing| and rest treatment are based on providing non grazing within the feasible grazing season during periods that are expected to enhance the forage stand.

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

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

Advantage:

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

Self-Check -2	Written Test

Directions:

Part I. Answer all the questions listed below.

1. Mentions the main aim of grazing management practices (3pts)
2. Define Grazing management. (2pts)
3. Describe two common grazing systems in a range land (2pts).

Part II Fill the Blank spaces

4. Change in rangeland conditions refers to_____, _____, _____ and _____ These changes occur due to _____ and _____ factors(5pts)

Note: **Satisfactory rating - 12 points** **Unsatisfactory – below 12 points**

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

Information sheet 3- Introducing and implementing processes to minimize waste and soil degradation

3.1. Minimizing feed waste

In semi-intensive and intensive systems, animals are offered feed while they are in confinement. Where properly managed, such mode of feeding encourages the efficient and proper use of feed. The effectiveness of the practices demands the following:

3.1.1. Sanitation of feeding platforms

This involves keeping the feeding platforms including feeders and floors dry and clean at all times. This sanitation process avoids the contamination of feed with animal faeces and urine. Clean feeders and floors allow the collection and the re-use of spilled feed by animals under confinement.

3.1.2. Forage material chopping

Chopping fibrous feed reduces the chances of feed spillover and facilitates the mixing of different feed sources. The practice also encourages the uniform consumption of thick stemmed and coarse forages, which is oftentimes poorly utilized.

3.1.3.Use of troughs and hayracks

The use of troughs is important to avoid the contamination of feed materials by faeces, urine or mud, and to discourage disease and parasite build-up. More importantly, troughs suiting the specific species, body size and age of animals reduces feed trampling, competition and wastage. As a general guide it is important to place troughs off the ground and provide them with barriers preventing animals from jumping into it. Likewise, hayracks, by allowing slow and orderly consumption of long dry and fresh forages, reduces feed wastage. It is necessary to construct hayracks in such a way that racks are set at head height and all animals' access the forage materials at the same time.

3.2. Management of invasive plant species

Invasive plant species are plants that alter the health and productive state of rangelands, and the socio-economic welfare of livestock keepers. Invasive plant species can either be of native or foreign origin. Such plant species have characteristic adaptive features that help them proliferate and rapidly spread across the rangeland ecosystem. With a supportive policy environment and appropriate institutional setup, the implementation of technical measures can help minimize or avoid the threat of invasive plant species.

The management of invasive species involve four key steps – prevention, early detection and rapid response, control and management, and rehabilitation and restoration.

3.3. Prevention:

This refers to actions put in place to deny invasive plant species from getting foothold in the rangeland ecosystem. It involves the proactive monitoring of the rangeland to prevent the introduction and spread of new and undesired invasive plants into the ecosystem. Such preventive measures include establishing herders' scouts and natural resource management committees who regularly monitor the rangelands, and conducting widestakeholders' workshops to educate and raise awareness on the threats of invasive plant species and reduce the chance for unintentional introduction of new invasive plant species.

3.4. Early detection and rapid response:

Detect and irradiate invasive plant species to stop them from invading. When new invasive species are detected, a quick and coordinated containment and eradication response can reduce environmental impacts and prevent the long-term commitment of scarce resources. Rapid response to new infestations results in lower cost and lesser damage to rangeland resources. Early detection of new infestations requires vigilance and regular monitoring of the rangeland.

3.5. Control and management:

Eliminate or control invasive plant species of priority importance. The strategic approach to consider while planning the control of the priority invasive species is timing, understand site condition and species biology, and follow-up monitoring.

3.6. Rehabilitation and restoration:

This refers to measures implemented to heal, minimize or reverse the harmful effects of invasive plant species. It involves the rehabilitation of the invaded areas to their ecological functions after the removal of the invasive species. More importantly, this would require preventing the re-establishment and reducing long-term costs

Self-Check -3	Written Test

Directions

Part I. Answer all the questions listed below.

1. Mention the effective practices of feeding in arid and semi arid areas to minimizing feed waste (5pts)

2. What are the four key steps involved in the management of invasive species? (4pts)

Part II. Choose the best answer.

1. _____ refers to measures implemented to heal, minimize or reverse the harmful effects of invasive plant species (2pts):
   A. control and management
   B. Rehabilitation and restoration
   C. prevention
   D. early detection and responses

Note: **Satisfactory rating - 11 points** **Unsatisfactory - below 11 points**

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

Information sheet 4 - Applying Principle of rangeland management

4.1. Principles of range management

Grazing intensity and frequency, as well as livestock selectivity, can be manipulated using the four principles of range management. These four principles-or variables that can be manipulated are:

- Kind and class,
- Number,
- Spatial distribution,
- Temporal distribution of livestock (Holechek et al.)

4.2. Methods of rangeland management

Prescribed fire, fertilization, and seeding are other management practices that can be used to improve degraded rangelands and maintain critical soil functions. In forests, soils are managed for wood and fiber production and other multiple uses such as water harvesting, recreation, and wildlife.

4.3. Range land management and utilization

The amount of plant material consumed and otherwise caused to disappear by herbivores, expressed as a percentage of the current herbage crop, has been known as range utilization, degree of use, percentage use, actual use, herbage use, and range use**.** These terms apply to single species as well as to the pasture as a whole. Actual use may be an expression of the AUMs obtained in a grazing season and thereby may be confused with stocking rate.

A distinction is made here between stocking, which is a daily phenomenon; range forage utilization, which is seasonal; and, grazing, which has a longer time reference. Thus, overstocking can be corrected in a day and overutilization in a growing season, but the results of overgrazing may take several years to eliminate with proper utilization each year.

Overstocking, if continued, results in overutilization, and if continued for years, will result in overgrazed or deteriorated range. In comparison, proper stocking results in proper utilization at the end of the grazing period and promotes maintenance or improvement in range condition. Other terms modifying utilization and suggesting different but seldom specifically defined conditions include close, destructive, extreme, full, light, local, moderate, slight, and severe.

Self-Check -4	Written Test

Directions

Part I. Answer all the questions listed below.

1. Mention the four principles-or variables of range management (4pts)

2. Indicate the duration and ways of correcting overstocking, overutilization and overgrazing (3pts)

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

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

LG # 46	**LO3. Assess rangeland condition and trend**

Instruction sheet

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

- Monitoring soil structure and erosion
- Assessing rangeland uses and stakeholders
- Identifying analogy to human health of rangeland condition
- Carrying out assessment of rangeland trend
- Determining rangeland assessing approach
- identifying feed surpluses and deficiencies and taking appropriate action

Assessing pasture maturity 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 –**

- Monitor soil structure and erosion
- Assess rangeland uses and stakeholders
- Identify analogy to human health of rangeland condition
- Carry out assessment of rangeland trend
- Determine rangeland assessing approach
- identify feed surpluses and deficiencies and taking appropriate action

Learning Instructions:

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

7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information sheet 1- Monitoring soil structure and erosion

1.1. Management systems

Soil-quality and land management have the dual goals of meeting the needs of society and conserving essential soil, water, and air resources for future generations. Rangelands are managed for forage production, water harvesting, recreation, and wildlife production, fire wood, and construction materials. On rangelands, management is heavily focused on vegetation. In these systems, animal stocking rates are managed to maintain vegetation composition and productivity, while water-source and mineral-supplement locations are used to improve animal distribution and avoid overgrazing and compaction of the soil. Avoiding compaction and maintaining vegetative cover reduces the potential for erosion and maintains water quality in rangeland watersheds. Prescribed fire, fertilization, and seeding are other management practices that can be used to improve degraded rangelands and maintain critical soil functions.

In forests, soils are managed for wood and fiber production and other multiple uses such as water harvesting, recreation, and wildlife. During timber-harvesting operations, soil quality is maintained by using practices that minimize the potential for erosion and restore vegetative cover as quickly as possible. Prescribed fire, fertilization, and seeding (or seedling transplants) can be used to improve site productivity and maintain critical soil functions.

In agriculture, soils are managed primarily for the production of food and fiber. Historically, tillage has been used to prepare a seedbed, incorporate residue, control weeds, and distribute agricultural chemicals. Inorganic fertilizer, animal manure, or other organic by-products are applied to provide nutrients needed by the crop but not supplied in sufficient quantities by the soil or to replace nutrients removed by the harvested crop. Soil quality monitoring allows agricultural managers to make assessments of the effects of various combinations of these management factors in the overall system.

1.2. Tactics for managing the soil surface

- Maintain growing pastures near the start of growth phase II (about 1,200kg green DM/ha) for as long as possible to aid regrowth. This has the added benefit of ensuring the highest possible pasture quality for grazing stock.
- Maintain (or increase) ground cover to manage run-off by removing stock before minimum pasture mass limits are reached (1,200kg DM/ha).
- Aim for medium to high levels of litter (at least two or three handfuls in a 30 × 30cm area) to increase soil organic matter, protect the soil surface, decrease evaporation and increase water-holding capacity. Litter is preferably actively decaying plant matter, not old and inert material.
- Manage grazing practice to increase litter quality and breakdown rate.
- Avoiding excessive cultivation and the application of soil biota-reducing chemicals to encourage build-up of soil biota, to improve soil structure (increased porosity or aeration), litter breakdown rates and incorporation of surface organic matter.
- Avoid grazing when soil is waterlogged to prevent pugging (where animals hooves work clay or loam soil into a soft, plastic condition with no porosity)
- Create stock containment areas to remove stock from at-risk grazing areas.
- Change the pasture composition to deep-rooted perennials to ameliorate soils with declining structure.

1.3. Rangeland degradation

One of the most important factor affecting the soil structure of a given range land is range land degradation due to several factors/causes.

Range land degradation consists of a reduction in quantity or nutritional quality of the vegetation available for grazing. The prospect of increased rangeland degradation is common in to all dry land areas. In particular, the deterioration is more advanced in semi arid and sub humid areas than in arid areas.

1.3.1. Causes of range land degradation

- Overgrazing and overstocking rate

- Lack (shortage) of rainfall (pastoral/agro-pastoral areas
- Tree/bush clearing and use of wood for fire
- Competition of land for cultivation and grazing
- Population pressure
- Unscientific management
- Communal system of grazing (common property)
- Decreased mobility of pastoralists
- Climate change

1.3.2. Effects of range land degradation

- Decreased forage availability in the ranges providing nutrient for herbivores lead to reduction both in grazing and browsing capacity
    - ✓ deterioration in body condition of animal
    - ✓ deterioration in performance of animal
- Environmental degradation/loss of range land biodiversity
- Reduction in woody and herbaceous biomes
- Replacement of desirable forage with undesirable (unpalatable)plants
- Decreased soil fertility due to loss of plant cover
- Decreased absorption of rain fall by soil

1.4. Rangeland management and restoration measures

Rangeland management restoration refers to sound management practices that optimize the health and productivity of grasslands. It involves defining the objectives and preparing a detailed work plan for the implementation of rangeland management good practices. Among others, the core priority tasks constitute the rangeland stakeholders' analysis and resources appraisal. Effective implementation of these priority tasks helps impart the sense of ownership and facilitate the implementation of sound management measures to restore the health and productivity of the rangelands. A variety of rangeland restoration measures is available.

1.4.1. Stock exclusion

Stock exclusion is a rangeland management practice where we rest the grazing land for at least one growing season. Periodic resting of rangelands encourages the emergence of range plants from soil seed banks and the regrowth of shoots from dormant stalks. Depending on the state of the rangelands and the climatic conditions, the resting period could last for one or couple of growing seasons. With the release of the grazing pressure, grass and other forage plants from soil seed banks and weakened stands start to emerge and improve the vegetation cover. Periodic resting reduces the exposure of the soil surface to all kinds of erosion, increases the infiltration of rainwater and recharges the ground water

1.4.2. Reinforce rangeland through reseeding

Rangeland reseeding is the manipulation of the forage species mix. The practice improves the feeding value and biomass production capacity of the rangelands. Such actions are particularly important in rangelands that have lost the vegetation cover and soil seed banks due to prolonged heavy grazing. Rangeland reseeding is simple and relatively less costly as it requires small amount of seed and less elaborate seedbed preparation.

Self-Check -1	Written Test

Directions: Answer all the questions listed below.

1. Mention major methods of Rangeland management and restoration measures (3pts)

_____
_____
_____

2. what is the reason of reinforcing rangeland through reseeding (3pts)

-

_____
_____
_____

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

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

Information sheet 2. Assessing rangeland uses and stakeholders

2.1. Rangeland uses and stakeholders

As noted in the previous Introduction, rangelands are used by groups of people for many purposes. A few of these uses, among many, include:

- People practicing traditional and common pastoralism
- To those conserving landscapes and habitats for biota and tourism,
- To miners exploring for, and extracting, minerals,
- To indigenous people practicing traditional customs and hunting, gathering and trading resources.

In this module the term 'stakeholder' to denote these groups of people who have an interest in the rangelands. This definition of stakeholder includes those groups of people who may not live within a rangeland area, but who have a concern for their condition or health including, for example, overseas tourists, members of global and national land conservation organizations, which typically are non-government organizations (NGOs), and governmental land managers and policy-makers who typically live in capital cities.

These stakeholder groups will have different visions and goals for the use of rangelands. Stakeholder visions and goals for using rangelands are ideally defined in participatory settings, such as workshops. For example, a series of workshops were held to define stakeholder visions and goals for the use of rangelands in the tropical range lands. Although Aboriginal, conservation and pastoral stakeholder groups shared a similar general vision centred on having healthy country, their specific visions and objectives for use of these rangelands differed considerably, as might be expected. Because of their different visions and objectives, the expectation is that each stakeholder group will focus on different attributes and indicators being monitored to define the functional state of a rangeland system. Using the same information about the status of the system, each stakeholder group will evaluate its 'condition' or 'health' quite differently, resulting in conflicting statements which need to be resolved.

Self-Check -2	Written Test

directions: Answer all the questions listed below.

1. Mention the purposes using rangelands by groups of people (4pts)

_____
_____
_____
_____

2. Define stalk holders in the context of range land management and uses.(2pts)

_____
_____
_____

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

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

Information sheet 3 Identifying analogy to human health of rangeland condition

3.1. Rangeland condition

Issues on evaluating rangeland condition or health can be viewed as having two main components: first, how do individual stakeholders assess the information available on the functional state of the rangeland area of interest and judge its condition relative to their visions and values, and second, if the area of rangeland is being evaluated by multiple stakeholders having different visions and values, how to best resolve any conflicting statements on the condition or health of the rangeland.

3.2. An analogy to human health

The term 'condition' in standard dictionaries means "state of being" or "health". In human health terms, poor health is a 'state of being' in reference to good health, which is typically assessed in terms of easily measured indicators such as body temperature, blood pressure, and resting heart rate. Rangeland condition is analogous. It is a human perception of the state of health of a rangeland area in reference to an area perceived to be in a state of good health – a reference or benchmark site. This notion or concept of assessing rangeland condition or health relative to a benchmark is not new, being applied in the 1940s to assessing changes in forage plant composition away from a theoretical 'climax community' composition. The state of the benchmark site, and other rangeland sites of interest, can be defined by a set of easily measured indicators related to, for example,

- Production,
- Conservation and
- Aesthetic values (Keith and Gorrod 2006).

Given such indicators, the state or condition of the rangeland site is judged by people (stakeholders) to be in a given state of health relative to the benchmark site. This health analogy is widely used, especially in developed countries, and it has proven useful for talking about the state of rangelands. Some authors caution about "pushing the analogy too far" and others recommend against the use of the term 'health' because it is too value-laden and its meaning will change as society's views and values change. In this context, we argue for the use of rangeland 'health' while acknowledging that assessing it is a value judgment.

Self-Check -3	Written Test

Directions: Answer all the questions listed below.

1. Explain briefly the analogy/ correspondence of rangeland condition to human health. (2pts)

   _____
   _____

2. The state of the benchmark site, and other rangeland sites of interest, can be defined by a set of easily measured indicators related _____, _____ and _____ (3pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

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

Information sheet 4 Carrying out assessment of rangeland trend

4.1. Range condition and trend

The concept of range condition embodies and expresses the characteristics of a named site at a given time and is in terms of nearness to an ecological or use standard, Trend is the change in those characteristics toward or away from the standard**.**

Range condition is the subject of inventory.

Trend is an objective of monitoring. Parameters used in the measurement of condition and trend, have been proportional species composition but the species have been, classified differently. Abundance, cover, forage value, biomass, successional status, and palatability have been used, none of which have been satisfactory for all purposes**.**

Soil condition and erosion hazard have been secondary parameters because they are difficult to combine with the vegetation measurements into a single term. The use of one or several, parameters for determination of condition and trend is a subject of disagreement.

4.2. Range condition classification

Range condition classification is often included in a range inventory changes. In range condition scores overtimes are usually the basis for monitoring management effectiveness. Range condition classification provides an induction of management necessary. If ranges are in good or excellent condition, maintaining them in a stable condition may be the best management strategy. However, if they are in poor or fair condition, management is aimed at "improvement" may be indicated.

Generally, four or five condition classes are recognized. These are excellent, good, fair and poor. Sometimes, a fifth category is added. Many approaches have been used to determine range condition on different range sites or habitat types. Of these, the most familiar method is developed by Dyksterhuis (1949, 1958). This approach is ecological.

Range condition is measured by the extent to which it departs from climax. The approach assumes that climax can be determined for each range sites. Excellent class would represent climax, i.e.

- Excellent (76-100) % of climax

- Good (51-75) % of climax
- Fair (26-50) % of climax, and
- Poor (0-25) % of climax respectively.

Originally, species occurring on each site were classified, by their reaction to grazing, as Decreasers, Increasers, or Invaders. Decreasers are highly palatable plants that decline in abundance with grazing pressure.

Plants classified **as increaser I** types are moderately palatable and serve secondary forage plants. They may increase slightly or remain stable under moderate grazing condition reaches fair condition. Other plant species are present in the climax vegetation, but those that are unpalatable may increase under grazing pressure or as site deterioration occurs. These species are classified **as increaser II** plants. Invaders are species that encroach on to the sites from adjacent sites in a later stage of deterioration. Type **I invaders** may eventually decrease if forced utilization occurs at later stages of deterioration. Type II invaders are generally unpalatable and increase though final stages of deterioration.

The differences between condition classes are sometime arbitrary since they really form a continuum, from badly depleted range areas to those with maximum cover and productivity.

It is important to distinguish changes in vegetation overtime on one site from vegetation differences from site to site at the same time

The following rates are used determine range condition

Plant characteristics	Percent climax	Soil characteristics
Dense stand of tall, deep rooted perennial grasses. Few shrubs and sod grasses	100% Excellent	Loamy, dark soil, rich in OM High moisture content
Short perennial grasses and forbs. Some shrubs	75% good	Loamy to sandy soil. Moderate moisture
Annual forbs and grasses	50% fair	Gravely loam. Little OM. Little moisture
Low plant forms. Lichens, fungi work on rocks	25% poor	Little breakdown into coarse rocks
Bare rock		Bare rock (dry)

4.3. Range condition analyses

Range condition

- Relates the *current* condition of the range to the potential condition
- Is a measure of state of health of the range
- Is not related to the immediate amount of forage available
- Forms basis for adjusting stocking rates
    - ✓ (not for communal systems)
- Ecological concepts underlie range condition
    - ✓ Climax vegetation
    - ✓ Plant succession

4.4. Environmental factors influencing range condition:

- Climatic
- Edaphic (soil)
- Biotic (grazing, fire)
- Much of world's rangeland never reach climax status due to these factors
- Most rangelands have secondary succession as a climax (e.g. Under annual fires)

4.5. Judging range condition from plant composition:

- Condition rating is based on the relative contribution per category
- Example of 4 ratings:
    - ✓ Excellent: many decreasers
    - ✓ Good: less than excellent decreasers, more increasers
    - ✓ Fair: similar amounts of decreasers, increasers and invaders
    - ✓ Poor: many invaders

4.6. Quantification of range condition ratings

Multiple-Factor systems:

- Grass composition
- Basal cover
- Litter cover

- No. of seedlings
- Age distribution
- Soil erosion
- Soil compaction

A**. Overall range condition depends on all factors considered**,e.g

- Excellent 41-50 points
- Good 31-40 points
- Fair 21-30 points
- Poor 11-20 points
- Very poor 3-10 points

A. **Grass composition**:

- Three plants classes according to succession theory (decreasers, increasers, pioneers)
- Plant lists fitting different areas are required
    - local herdsmen useful resource
- Points according to scale, e.g. 1 to 10
- Proportion of each spp. can be assessed in an imaginary circle of 5 to 10 m radius in a representative area

B. Basal cover and litter cover:

- Representative sample area of 1 m^2
- The 1 m^2 is divided into eights
- Transfer of all plants bases of the 1 m^2 to one eight for visual estimations
- Only basal covers of living parts
- Rating 1 to 10
- Litter in same 1 m^2

C. **No. of seedlings and age distribution***:*

- No. of seedling counted on A4
    - ✓ In triplicates
- Age categories young, medium and old

- ✓ young up to 20% of biomass of old/mature
- ✓ medium up to 50% of biomass of old/mature
- ✓ of dominant species

D. Soil erosion and compaction:

- Based on amount of pedestals
  - ✓ (higher parts of soils, held together by plant roots, with eroded soil around the tuft)
  - Based on amount of pavements
  - ✓ (terraces of flat soil, normally without basal cover, with a line of tufts between pavements)

E. Condition largely determined by position in the landscape:

- Topography main cause of differences within vegetation type
- Naturally poor sites must be recognized
- Range condition analyses are useful only to the extent that natural site variations are recognized

F. **Climax vegetation not necessarily constant**: due to

- Drought
- Differences in grazing pressure
- Differences in fire management

4.7. Range trend

It is the direction of change in ecological status or resource value rating observed over time. It is a state of degree of either deterioration or improvement or remains in the same condition. Repeated evaluation of the plants and soil condition is essential to determine range trend. The most useful factor indicating the range trend is reproduction of the desirable species, young, medium sized and large plants indicate that the species is regenerating (improving trend). Fewer and fewer desirable forage plants, increasing erosion of bare soil, increase weedy plants and undesirable species indicates down ward trend on range land.

4.8. Assessing Rangeland Trend

I. Rangeland Trend, according to the Soc. For Range Management is “the direction of change in range condition and soils”.

A. Range condition alone is not an accurate indicator of correctness of current management practices. Many improper practices could be taking place that would not be detected through species composition analysis. Poor range condition of a range does not necessarily indicate that the present practices are wrong; the area could be properly stocked. On the other hand, excellent range condition does not mean that the current practices are correct, because, it could very well be an improperly managed range which is either at the point of, or in the process of deterioration.

B. Trend is considered upward (improving) if the community is becoming more similar to climax or DPC or downward (declining) if the community is becoming less similar to climax or DPC or stable if the community is not changing.

C. When assessing range condition for a desired use or DPC, trend could be upward for one use and downward for another. Therefore, to determine trend, one must specify the use criteria or DPC .

II. There are basically 2 ways to measure trend:

A. Monitor range condition over several years. Changes in range condition can then be identified.

B. Apparent trend can be detected by looking at plant and soil characteristics. Apparent trend is not as definitive as taking data over time, but it is instantaneous; you don’t need years of data to determine apparent trend.

III. Example of Apparent Trend.

These criteria should be modified and made site-specific.

Downward Trend (Plants)

- Better forage plants unavailable to livestock.
- Better forage plants confined to protection of shrubs. Hedged and high lined shrubs.
- Dead and dying hedged plants

- Lack of reproduction of young plants of desirable species.
- Invasion by undesirable plants.
- Desirable plants lacking vigor.
- Scarcity of litter of desirable plants.

Upward Trend (Plants)

- Better forage plants invading and readily available to livestock and wildlife; in the openings between shrubs.
- Invasion of plants into eroded areas. basal parts of plants flush with the ground surface.
- Several years' growth from hedged browse. At least 2 or more years of regrowth evident.
- Desirable plants vigorous. Many leaves, seed stalks tall and numerous, leaves a healthy green color.
- A variety of age classes of desirable plants.
- A well dispersed accumulation of litter from past years growth.

Downward Trend (Soils)

- Rill marks. Small active gullies of the shoestring type.
- Active gullies. From a few inches to several feet deep.
- Alluvial deposits Laid down by running water. Absence of perennial vegetation on the deposits.
- Active terraces. "Stair-step-like" on slopes.
- Exposed plant crowns or roots.
- Wind scoured depressions between plants.
- Wind deposits. Fine soil particles drifted into the vegetation.

Upward Trend

- Gullies healed. Perennial vegetation on both sides and bottom.
- Sloping-sided soil remnants. Plant roots are covered by soil. Space occupied by perennial plants.
- Healed terraces. Sloping sites and tops clothed with vegetation

Self-Check -3	Written Test

Directions: Answer all the questions listed below.

1. Explain the reasons why climax vegetation is not necessarily constant (3pts)

2. Mention two examples of each upward and down ward trends indications of plants in a range conditions(4pts)

3. Mention Multiple-Factor systems quantification of range condition ratings.(4pts)

4. Define deceasers and increasers.(2pts)

Note: **Satisfactory rating - 13 points** **Unsatisfactory - below 13 points**

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

Information sheet 5. Determining rangeland assessing approach

5.1. Assessing Rangeland Condition

I. **Rangeland Condition**

The current state (e.g., plant composition) of a particular plant community in comparison to some perceived potential.

II. Why determine range condition?

A. It indicates management inputs necessary. For example, if range is in high ecological condition than strategies to maintain condition should be employed. However, if range is in degraded condition, strategies to improve condition should be considered.

B. On public rangelands, range condition is assessed and reported as a way of being accountable to the "public" regarding the current state of public resources.

III. Traditional Approach to assessing rangeland condition.

A. First, the type of land being assessed must be determined to understand the natural potential of the land. In other words, determine what kind of community the particular combination of soil, climate and topography can support.

1, Range site

According to the Society for Range Management = "a distinct kind of rangeland, which in the absence of abnormal disturbance and physical site deterioration, has the potential to support a native plant community typified by an association of species different from that of other sites. The differentiation is based upon significant differences in kind or proportion of species, or total productivity".

- Range sites are classification based on:
  - ✓ Soils (depth, texture, soil limiting factor)
  - ✓ Topography
  - ✓ Current vegetation

- ✓ Precipitation zone

- Range sites
  - ✓ Sites named by soil and topography (e.g., shallow stony loam)
  - ✓ Sites vary by region and county (e.g. shallow stony loam sites may vary slightly by county).
  - ✓ County Soil Surveys, published by the Natural Resources Conservation Service, will list or describe sties and complete range site guides are available at each county office of the NRCS.

2. **Habitat types**,

As defined by Daubenmier, = “a term for all parts of the earth’s surface which support or is capable of supporting the same kind of plant association (i.e., have the same “climax”).

- Classified by dominant climax vegetation (i.e., Art.tri/Agr.spi.)
- Technique originally developed for forest types, later applied to rangeland.
- The classification is used by the Forest Service and Bureau of Land Management. Classification guides and manuals are available from these agencies on a regional basis

B. Second, the species composition of the site must be determined. Follow methods for determining rangeland composition. Most range sites descriptions are based on % by dry weight. Therefore, composition techniques based on biomass are most appropriate.

C. Third, compare current state to climax or pristine vegetation. (Composition of climax or pristine communities can be found in range site or habitat type guides)

D. Fourth, designate condition class.

1. Excellent = 76-100% of Climax
2. Good = 51-75% of Climax
3. Fair = 26-50% of Climax
4. Poor = 0-25% of Climax

E. Problems with the traditional range condition system

1. Terms (excellent, good, fair and poor) are value ridden and may not be useful in management.

- Terms may not be relevant to management objectives. For example, excellent condition range may not be the best for livestock production or wildlife habitat.
- Terms also have value connotations that uneducated, but interested, publics may misunderstand. For example, as a land manager you may at some time
- manage an area of land for fair condition, but an interested citizen may demand that you manage for “excellent” condition because they think it is better.
- The terms climax, high seral, mid-seral, and low seral have been suggested as substitutes because they carry no inherent value and relate closely to ecological uses and outputs (such as wildlife habitat, watershed characteristics, etc.)

2. Determining climax is very difficult. It is difficult to impossible to find examples of undisturbed native vegetation. Therefore, many guidelines on climax composition are based more on expert opinion than data.
3. Our idea of climax is that it is a stable community that will result without unnatural disturbance. However, ecological research has revealed that many climax communities are not “stable; they vary significantly from year to year.
4. The site we are evaluating may be a transition between sites and may not be typical. Therefore, it is difficult to know what to compare the site to.
5. The method does not provide a reasonable way to include exotic species in the assessment even though some exotic species may have significant value for specific uses such as livestock grazing.

IV. Desired Use or Desired Plant Community (DPC) Approach

A. Determine management goals for site:

- Livestock
- Wildlife
- Watershed
- Recreation and etc.

B. Describe what site should look like to meet the management goals. In other words, clearly define your DPC.

C. Evaluate site potential in reference to goals

- Refer to value for use (e.g., wildlife, watershed) listed in range site guides or habitat type references
- Look at ability of land to meet desired state and make adjustments.

D. Give rating to land in reference to goal. For example:

- Good for deer and elk.
- Adequate for watershed

V. Site Potential or Proper Functioning Approach

A. This is an assessment of land to determine if it is ecologically in tact.

- Is soil stable?
- Are carbon and nitrogen cycles functioning properly?
- Is the water cycle in tact (e.g., infiltration, water table, run off)?

B. This approach stresses soil health and stability, and vegetative reproduction.

C. First, look at land attributes

- Soil Stability
- Vegetation Production, Composition, Diversity.

D. Locate a reference site that is in high ecological condition. Basically, try to find an area with little “unnatural” disturbance.

E. Compare the site you are evaluating to the reference site to subjectively assess if the site is ecologically sound. The comparison with the reference site is designed to increase the value of the subjective decision and make procedure usable by a group of people. For example, a group of people could then discuss the ecological soundness of a specific area as it differs or is similar to the reference site.

5.2. Succession and climax

Plant Succession: is the process whereby one association or species replaces another, until the final community is reached. This final, somewhat stable is often called the climax. Such a succession usually is gradual and involves a series of changes that follow a more or less regular course. Succession results from a change in habitat and invasion of new species. Change of environment or habitat results in change of the plant cover adapted to the area.

Grouped **as*:***

Primary Succession: The term primary succession generally is applied to natural plant succession on previously unvegetated areas leading to a climax. The processes of primary succession can be summarized as follows:

- The development of soil from parent materials
- Increasing longevity with successional advance
- Replacement of species with broad ecological requirements by those occupying narrow niches complementary with other species
- Greater accumulation of living tissue and litter per unit area with successional advance
- Modification of micro environment extremes
- Change in size of plant from smaller to larger
- Increase in the number of path ways of energy flow
- More nutrients tied up in living and dead organic matter
- Greater resistance to fluctuation in the controlling factors

Secondary Succession: Takes place or usually induced on land which previously has been occupied by highly developed vegetation destroyed by some unusual factor such as fire etc. Range managers routinely deal with secondary succession, but rarely with primary succession.

Plant Succession can occur in different forms:

A. **Progressive Plant Succession**:

Occur when plant biomass increased in terms of plant cover, density of foliage above the ground including the height of the plants.

e.g. Smaller plant forms such as herbs and shrubs by higher forms of plants such as trees.

B. **Retrogressive Plant Succession*:*** any of a great number of actions may disturb the climax plant cover and bring about retrogression leading away from the climax. Occur when climax plant community is disturbed by factors such as fire, over grazing and drought etc.

C. **Autogenic succession**: is a succession where both the plant community and environment change, and this change is caused by the activities of the plants over time. After the last volcanic eruption.

D. **Allogeneic succession**: is caused by a change in environmental conditions which in turn influences the composition of the plant community. In Cornwall England, observations on the estuary of the Fal river suggest that the deposition of silt may be causing an allogeneic succession from salt marsh to woodland

-

Self-Check -5	Written Test

Directions: Answer all the questions listed below.

1. What are Desired Plant Community (DPC) Approach considers (4pts)

2. In site Potential or Proper Functioning Approach, an assessment of land used to determine if it is ecologically in tact_____,_____ and _____ (3pts)

3. Mention the difference between Progressive Plant Succession and Retrogressive Plant Succession(4pts)

4. _____ is a succession where both the plant community and environment change, and this change is caused by the activities of the plants over time.(2pts)

Note: **Satisfactory rating - 13 points** **Unsatisfactory - below 13 points**

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

Information sheet 6. Identifying feed surpluses and deficiencies and taking appropriate action

6.1. Introduction

As, stated in different topics there are times in which a pasture productivities are higher than the demand by the animals and there are also some seasons in which forge scarcity may happens. To bridge these seasonal variability gap, it is very important to conserve feed as a form of hay and silage and feed the animals year round.

6.2. Feed conservation, processing, packaging and feeding

6.2.1. Feed conservation

Feed conservation is useful to stabilize the year-round supply of livestock feed. It eases storage, minimizes wastage, maintains feed quality and diversifies the sources of supplemental feed. The stable supply of feed, particularly during the peak dry season, prevents loss of livestock body weight and sharp drop in milk production and increased vulnerability to diseases and parasites.

There are several methods, which producers could use to efficiently store and preserve forages for lean periods. It is also important to recognize the fact that conserved materials do not match the nutritive value of fresh forage. This is so because conserved feed looses part of its digestible nutrients (proteins, sugar and fat) in the course of storage and conservation. Proper feed conservation and storage, however, can minimize such nutrient losses.

E. Timing forage harvesting for hay or silage

Appropriate decisions on the forage harvesting time help conserve forage DM biomass with reasonable quality. Harvesting forage at vegetative stage of growth produces biomass with high crude protein, intake and digestibility values but severely compromise DM yield. As a thumb rule, it is good to harvest grass and leguminous forage as soon as the floral parts start to emerge. This is a period where one notices visible signs of change in plant growth from vegetative to reproductive stage.

F. Suitability of conservation techniques

The suitability of conservation techniques is dependent on a number of conditions. Among others, these include forage morphological characteristics, storage facilities, weather condition and the intended use of the conserved forage material. Irrespective of the weather condition, rangeland forages, improved fodder crops and crop residues with thick stocks and high moisture content suit the silage-based feed conservation. Cactus (Opuntia ficus indica), elephant grass, and any succulent freshly harvested fibrous feed fall under this category. On the contrary, fine-stalked forages can ideally be conserved as hay. Forage sources that suit haymaking are native and improved grasses, legume leaf meals and shrub/tree pods.

- Good quality hay production is subject to the following conditions: Use of forages with fine stems. Harvest forage while young and the leaf–stem ratio is high. Rapid and proper drying. Control of risks compromising safety and quality, i.e. shattering of leaves, exposure to rain and excessive sunlight exposure
- Critical issues to consider in the production of good quality silage: Harvest pasture as soon as floral part starts to emerge and then wilt it. Use additives where ensiled materials are low in soluble sugar to assist with fermentation. Chop (if coarse stemmed), compact, and seal ensiled material to ensure anaerobic conditions.
- Processing and packaging of conserved forage is important. It helps to: Reduce bulk, save storage space, ease feed handling and transport. Introduce livestock feed need planning and budgeting. Introduce standardized conserved forage trade

6.3. Feed supplementation

Benefits and timing of strategic feed supplementation

Why supplement grazing animals?

Feed supplementation is an integral part of good animal husbandry practices. Feed supplements are put into use to achieve the following objectives:

6.3.1. Bridge or meet deficient nutrient(s)

Feed that constitute the bulk of grazing animals' diet, namely range forages and crop residues, oftentimes are deficient in one or more essential nutrients. Failure to supplement deficient nutrient(s) severely suppresses rumen functions, DM digestibility and hence animal performance. Deficient nutrient(s) are administered in a variety of way, for minerals and vitamins through a drench, rumen bolus or injection, and as part of the ration for protein and energy related deficiencies.

6.3.2. Improve the utilization of feed in relative abundance

Here, the objective is to create a rumen environment that enhances microbial degradation of the abundantly available fibrous feed. In this circumstance, feed supplements help maintain optimum rumen environment for increased utilization of the poor quality fibrous feed.

6.3.3. Prevent scouring

Using dry roughage as a supplement could become necessary when animals graze on lush grass commonly high in moisture. Feeding dry forage reduces scouring and slows the passage of forage through the rumen thereby increasing nutrient uptake and pasture utilization. Feeding animals with dry roughage also reduces the risks of bloating in places and times such incidences are high.

6.3.4. Speed recovery from nutritional stress

During drought or periods of extended dry spell, the quality and quantity of feed decreases thereby limiting animal nutrient intake and causing substantial loss of tissues or body condition. The body tissues reduced during these periods are deposited when adequate animal feed intake is restored. Rapid recovery of the undernourished livestock and resumption of production and reproduction would require a feed supplement with sufficient digestible nutrients. Legume-based forage are ideal supplements

6.3.5. Increase production and reproduction

Growing, breeding, pregnant, lactating or working animals require the consumption of feed over and above the maintenance requirement. When animals in such physiological states are not given supplementary feed.

6.4. Take corrective action if pasture composition is inadequate

6.4.1. Where practical, change management to bring pasture composition within desired limits by:

- Grazing or cutting to increase plant tillering. Using high density, short-term grazing or cutting to prevent undesirable annual grasses from reseeding and maintaining perennial grass and clover cover to limit germination of annuals in autumn (follow the grazing management tactics to increase, maintain or decrease individual species
- addressing soil health and soil fertiliser content for the most responsive and desirable species
- tactical using herbicides to control weeds (eg low chemical rates in a spray-graze operation to stop seeding or higher rates of selective or non-selective herbicides to kill targeted weeds); low rates of chemicals applied over prolonged periods may result in target weeds becoming resistant
- allowing desirable pasture species to recruit through setting and dropping seed before grazing or cutting. Note that this is not effective for some species, such as phalaris
- improving pasture growth rate, quality and persistence
- extending the spread of desirable plant growth patterns where there is sufficient soil moisture to sustain growth or introduce deeper-rooted species to improve access to nutrients and soil water
- encouraging species diversity in and across all pasture zones
- Improving pasture performance in unfavorable conditions, such as more tolerant species for acid soils where liming is not economical or practical.

6.4.2. When cost-effective management practices do not achieve best possible pasture productivity, consider establishing perennial species and cultivars that are proven to improve capability. Aim to achieve

- improved pasture growth rate, quality and persistence
- extended spread of desirable plant growth patterns where there is sufficient soil moisture to sustain growth, or introduce deeper rooted species to improve access to nutrients and soil water
- species diversity in and across all pasture zones
- pasture performance in unfavorable conditions, such as more tolerant species for acid soils where liming is not economical or practical.

Self-Check - 6	Written test

Directions: Answer all the questions listed below.

1. Explain the objectives of feed supplementation(4pts)

2. Mention the condition to which good quality hay production subjected to? (4pts)

3. Mention the aim of considering establishing perennial species and cultivars that are proven to improve capability when other management is not cost effective. (5pts)

Note: **Satisfactory rating – 13 points** **Unsatisfactory - below 13 points**

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

Information sheet 7. Assessing pasture maturity

7.1. Pasture maturity

The palatability, intake and digestibility of forage drops with advance in the developmental stage of pasture. Conserve forage at growth stage where forage quality and quantity are optimized

7.2. Factors influencing Forage Nutritional Value

There are a number of the factors influencing the nutrient content, digestibility, and subsequent nutritional value of a forage. In this module content, the primary factor influencing the nutritional value of forages in the range land is the forage maturity at the time of harvest.

As a forage matures, maturation is associated with a decrease in the nutrient content, digestibility, and subsequent nutritional value of the forage. As a plant matures the contents of water, protein, nonstructural carbohydrates (i.e. energy), minerals, and vitamins decrease. In addition, the contents of the structural carbohydrates and lignin increase. Lignin is an indigestible compound. The rate and magnitude of change in nutritional value is dependent on a number of factors such as plant species and environmental conditions. Lignin is, in part, responsible for the decrease in digestibility as a plant matures. Lignin forms indigestible complexes with cellulose, hemicellulose, and proteins. In general, the amounts of lignin in the various plant species are:

Legumes > warm-season grasses > cool-season grasses.

For legumes, a range for lignin is from less than 6% to more than 10%. For grasses, a range for lignin is from less than 3% to more than 7%.

Figure illustrates the stage of maturity at harvest to maximize digestible dry-matter yield for legumes and grasses.

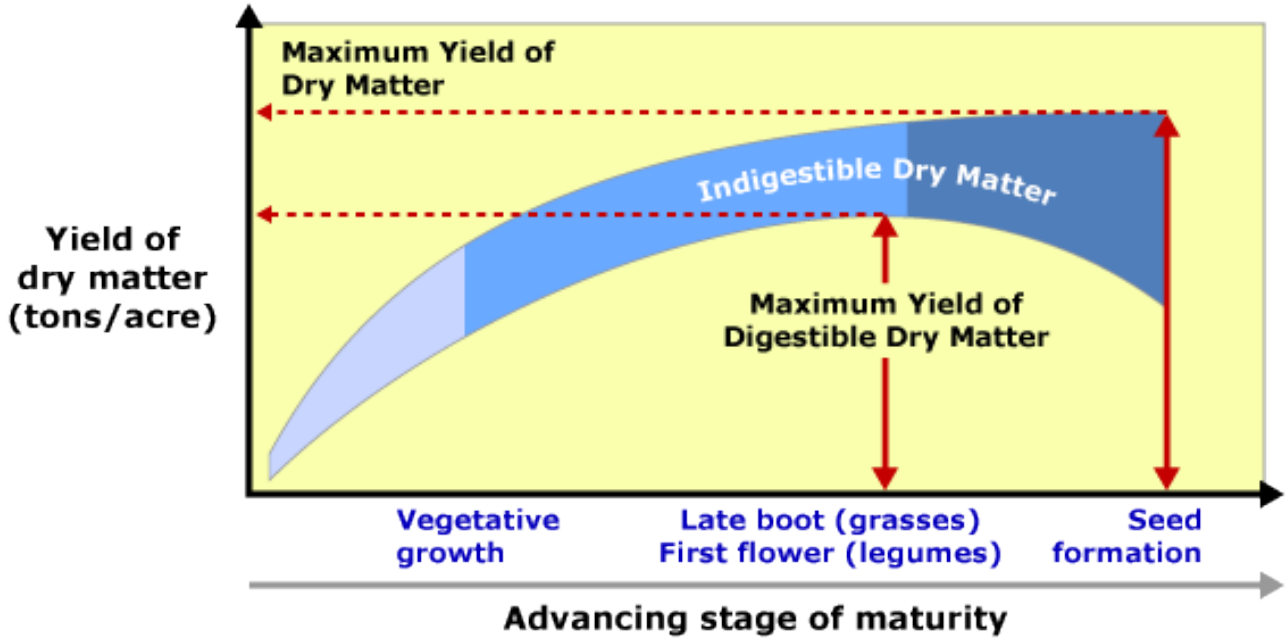

Figure 2: stage of maturity and dry matter content relationship.

One significant consequence of the decrease in digestibility as the plant matures is the association between digestibility and dry-matter intake; as digestibility decreases, dry-matter intake also decreases. Dry-matter intake is essential for nutrient intake to support maintenance and productive functions. As the digestibility of a forage decreases, the digestion and subsequent passage rates are also decreased. Therefore, dry-matter intake of the forage is limited by the physical volume required to contain the feedstuff prior to passage through the GI tract. Note, crude protein and mineral deficiencies also have the ability to limit intake. For crude protein, the typical crude protein content to maintain intake for a pasture forage is 7.5-8.0%. At this time, there is not an effective method to accurately relate forage digestibility and dry-matter intake.

7.2.1. Plant species and environmental and soil conditions

Plant species, especially between grasses and legumes, influences the nutritional value of the forage. Also within the classifications of grasses and legumes, the nutritional value varies. Environmental conditions such as the progression rate of the season and temperature and moisture levels and patterns of the season will influence the nutritional value of the forage. Soil conditions will also influence the nutritional value of a forage. For grass forages, nitrogen fertilization can significantly increase the crude protein content and dry-matter yield. Further, for a grass-legume forage system, excess nitrogen fertilization may result in the loss of the legumes in the system. As described in the text, a number of other associations between fertilization and nutritional value have been suggested.

7.2.2. Change in leaf to stem ratio

In addition to the change in nutrient content of the forage plant, the change in leaf to stem ratio also impacts the nutritional value of the forage. In general, the nutritional value of the leaves is greater than that of the stems. As legumes and grasses mature, the ratio of leaves to stems decreases, thus decreasing the nutritional value of the forage. In comparison to grasses, the extent of leaf loss is greater in legumes.

7.2.3. Effective management

Effective management of these factors such as appropriate selection of forage species, fertilization practices, and selection of stage of maturity at harvest will increase the overall nutritional value of the forage system. In addition, maintenance of the forage at a vegetative state, especially for grasses, can improve the nutritional value of the forage system.

7.3. Pasture quality

Assessment of pasture quality (energy content) normally requires full laboratory analysis. Field observations provide a useful guide to energy content in MJ ME/kg DM. Actively growing green material is normally in the range of 11.0–12.0MJ ME/kg DM. Actively growing legumes normally have slightly higher energy content (+ 0.5MJ ME/kg DM) than perennial grass.

Therefore pasture that is 100% green, has legume and perennial grass composition within the limits of 20–30% legume and 60–70% grass and the oldest leaf of the dominant grass has not started to senesce, can be assumed to have energy content greater than 11.5 MJ ME/kgDM.

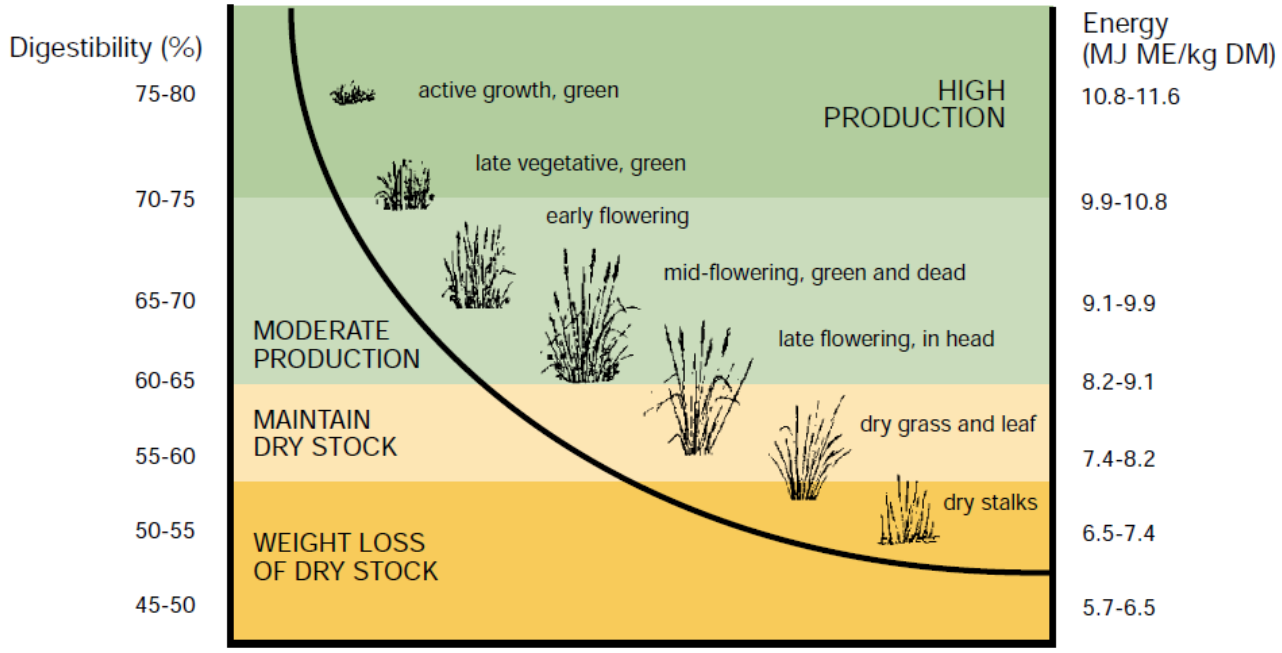

Figure 3: Guide to energy decline as temperate pastures mature

Self-Check - 7	Written test

Directions: Answer all the questions listed below.

1. Mention the factors influencing forage nutritional value and explain the impact of pasture maturity (5pts)

2. Describe how the energy content of pasture is assessed (2pts)

3. Mention the amount of MJ ME/kg DM of Actively growing green material and Actively growing legumes (4pts)

Note: **Satisfactory rating – 11 points** **Unsatisfactory - below 11 points**

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

Operation Sheet	Quadrat method of species composition assessment of range land

A quadrat is a means of defining a small sample area that can be assessed.

Steps to followed to conduct assessment

1. Prepare the necessary materials including PPE
2. Place quadrat on the ground randomly
3. Stand vertically above (helicopter view) the quadrat and estimate the proportion of the quadrat area occupied by each class of species
4. Record the proportions on the worksheet
5. Repeat the process until sufficient sites have been sampled
6. Calculate the average cover for each species.
7. Submit the findings and/or your result to the supervisor/instructor

LAP Test	Moisture content determination

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions:

Given necessary templates tools and materials you are required to perform the following tasks within **5** hours.

Task: Perform species composition assessment of range land

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