Animal Science

# General LPM (Livestock Production and Management) and Fodder Production

Grade 9

Government of Nepal
Ministry of Education, Science and Technology
Curriculum Development Centre
Sanothimi, Bhaktapur
Phone : 5639122/6634373/6635046/6630088
Website- https://www.moecdc.gov.np
Email- info@moecdc.gov.np

Technical and Vocational Stream
Learning Resource Material

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## Preface

The curriculum and curricular materials have been developed and revised on a regular basis with the aim of making education objective-oriented, practical, relevant and job oriented. It is necessary to instill the feelings of nationalism, national integrity and democratic spirit in students and equip them with morality, discipline, self-reliance, creativity and thoughtfulness. It is essential to develop linguistic and mathematical skills, knowledge of science, information and communication technology, environment, health and population and life skills in students. It is also necessary to bring the feeling of preserving and promoting arts and aesthetics, humanistic norms, values and ideals. It has become the need of the present time to make them aware of respect for ethnicity, gender, disabilities, languages, religions, cultures, regional diversity, human rights and social values to make them capable of playing the role of responsible citizens with applied technical and vocational knowledge and skills. This learning resource material for Animal Science has been developed in line with the Secondary Level Animal Science Curriculum with an aim to facilitate the students in their study and learning on the subject by incorporating the recommendations and feedback obtained from various schools, workshops, seminars and interaction programs attended by teachers, students and parents.

In bringing out the learning resource material in this form, the contribution of the Director General of CDC Mr. Yubaraj Paudel and members of the subject committee Dr. Manraj Kolakshpati, Madhukumari Tiwari, Lavdev Bhatta is highly acknowledged. The learning resource material is written by Dr. Ganesh Gautam Dr. Shibalal Bhandari and Dr. Asis Mahat the subject matter of the materials, was edited by Mr. Badrinath Timsina and Mr. Khilanath Dhamala and language was edited by Mr. Binod Raj Bhatta. CDC extends sincere thanks to all those who have contributed to developing this material in this form.

This learning resource material contains a wide coverage of subject matters and sample exercises which will help the learners to achieve the competencies and learning outcomes set in the curriculum. Each chapter in the material clearly and concisely deals with the subject matters required for the accomplishment of the learning outcomes. The Curriculum Development Centre always welcomes constructive feedback for the betterment of the material.

2082 BS

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# Guidelines to Teachers

## A. Facilitation Methods

The goal of this course is to combine the theoretical and practical aspects of the contents needed for the subject. The nature of contents included in this course demands the use of practical or learner focused facilitation processes. Therefore, the practical side of the facilitation process has been focused much. The instructor is expected to design and conduct a variety of practical methods, strategies or techniques which encourage students engage in the process of reflection, sharing, collaboration, exploration and innovation new ideas or learning. For this, the following teaching methods, strategies or techniques are suggested to adopt as per the course content nature and context.

### Brainstorming

Brainstorming is a technique of teaching which is creative thinking process. In this technique, students freely speak or share their ideas on a given topic. The instructor does not judge students' ideas as being right or wrong, but rather encourages them to think and speak creatively and innovatively. In brainstorming time, the instructor expects students to generate their tentative and rough ideas on a given topic which are not judgmental. It is, therefore, brainstorming is free-wheeling, non-judgmental and unstructured in nature. Students or participants are encouraged to freely express their ideas throughout the brainstorming time. Whiteboard and other visual aids can be used to help organize the ideas as they are developed. Following the brainstorming session, concepts are examined and ranked in order of importance, opening the door for more development and execution. Brainstorming is an effective technique for problem-solving, invention, and decision-making because it taps into the group's combined knowledge and creative ideas.

### Demonstration

Demonstration is a practical method of teaching in which the instructor shows

or demonstrates the actions, materials, or processes. While demonstrating something the students in the class see, observe, discuss and share ideas on a given topic. Most importantly, abstract and complicated concepts can be presented into visible form through demonstration. Visualization bridges the gap between abstract ideas and concrete manifestations by utilizing the innate human ability to think visually. This enables students to make better decisions, develop their creative potential, and obtain deeper insights across a variety of subject areas.

**Peer Discussion**

Peer conversation is a cooperative process where students converse with their peers to exchange viewpoints, share ideas, and jointly investigate subjects that are relevant or of mutual interest. Peer discussion is an effective teaching strategy used in the classroom to encourage critical thinking, active learning, and knowledge development. Peer discussions encourage students to express their ideas clearly, listen to opposing points of view, and participate in debate or dialogue, all of which contribute to a deeper comprehension and memory of the course material. Peer discussions also help participants develop critical communication and teamwork skills by teaching them how to effectively articulate their views, persuasively defend their positions, and constructively respond to criticism.

Peer conversation is essential for professional growth and community building outside of the classroom because it allows practitioners to share best practices, work together, and solve problems as a group. In addition to expanding their knowledge horizon and deepening their understanding, peer discussions help students build lasting relationships and a feeling of community within their peer networks.

**Group Work**

Group work is a technique of teaching where more than two students or participants work together to complete a task, solve a problem or discuss on a

given topic collaboratively. Group work is also a cooperative working process where students join and share their perspectives, abilities, and knowledge to take on challenging job or project. Group work in academic contexts promotes active learning, peer teaching, and the development of collaboration and communication skills. Group work helps individuals to do more together than they might individually do or achieve.

**Gallery Walk**

Gallery walk is a critical thinking strategy. It creates interactive learning environment in the classroom. It offers participants or students a structured way to observe exhibition or presentation and also provides opportunity to share ideas. It promotes peer-to-peer or group-to-group engagement by encouraging participants to observe, evaluate and comment on each other's work or ideas. Students who engage in this process improve their communication and critical thinking abilities in addition to their comprehension of the subject matter, which leads to a deeper and more sophisticated investigation of the subjects at hand.

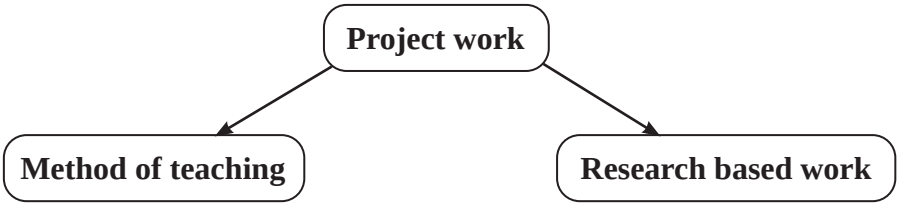
**Interaction**

The dynamic sharing of ideas, knowledge, and experiences between people or things is referred to as interaction, and it frequently takes place in social, academic, or professional settings. It includes a broad range of activities such as dialogue, collaboration or team work, negotiation, problem solving, etc. Mutual understanding, knowledge sharing, and interpersonal relationships are all facilitated by effective interaction. Interaction is essential for building relationships, encouraging learning, and stimulating creativity in both in-person and virtual contexts. Students can broaden their viewpoints, hone their abilities, and jointly achieve solutions to difficult problems by actively interacting with others.

**Project Work**

Project work is a special kind of work that consists of a problematic situation which requires systematic investigation to explore innovative ideas and solutions.

Project work can be used in two senses. First, it is a method of teaching in regular class. The next is: it is a research work that requires planned investigation to explore something new. This concept can be presented in the following figure.




Project work entails individuals or teams working together to achieve particular educational objectives. It consists of a number of organized tasks, activities, and deliverables. The end product is important for project work. Generally, project work will be carried out in three stages. They are:

- Planning
- Investigation
- Reporting

**B. Instructional Materials**

Instructional materials are the tools and resources that teachers use to help students. These resources/materials engage students, strengthen learning, and improve conceptual comprehension while supporting the educational goals of a course or program. Different learning styles and preferences can be accommodated by the variety of instructional resources available. Here are a few examples of typical educational resource types:

- Daily used materials
- Related Pictures
- Reference books
- **Slides and Presentation:** PowerPoint slides, keynote presentations, or other visual aids that help convey information in a visually appealing and organized manner.
- **Audiovisual Materials:** Videos, animations, podcasts, and other

multimedia resources that bring concepts to life and cater to auditory and visual learners.

- **Online Resources:** Websites, online articles, e-books, and other web-based materials that can be accessed for further reading and research.

**Maps, Charts, and Graphs:** Visual representations that help learners understand relationships, patterns, and trends in different subjects.

**Real-life Examples and Case Studies:** Stories, examples, or case studies that illustrate the practical application of theoretical concepts and principles.

### C. Assessment

**Formative Test**

**Classroom discussions:** Engage students in discussions to assess their understanding of concepts.

**Quizzes and polls:** Use short quizzes or polls to check comprehension during or after a lesson.

**Homework exercises:** Assign tasks that provide ongoing feedback on individual progress.

**Peer review:** Have students review and provide feedback on each other's work.

**Summative Test**

**Exams:** Conduct comprehensive exams at the end of a unit or semester.

**Final projects:** Assign projects that demonstrate overall understanding of the subject.

**Peer Assessment**

**Group projects:** Evaluate individual contributions within a group project.

**Peer feedback forms:** Provide structured forms for students to assess their peers.

**Classroom presentations:** Have students assess each other's presentations.

**Objective Test**

**Multiple-choice tests:** Use multiple-choice questions to assess knowledge.

**True/False questions:** Assess factual understanding with true/false questions.

**Matching exercises:** Evaluate associations between concepts or terms.

**Portfolio Assessment**

**Compilation of work:** Collect and assess a variety of student work samples.

**Reflection statements:** Ask students to write reflective statements about their work.

**Showcase events:** Organize events where students present their portfolios to peers or instructors.

**Observational Assessment**

**Classroom observations:** Observe students' behavior and engagement during class.

**Performance observations:** Assess practical skills through direct observation.

**Field trips:** Evaluate students' ability to apply knowledge in real-world settings.

# Introduction

Unit 1

## 1.1 Introduction to Animal Husbandry and Livestock Farming System in Nepal

Animal Production and Management is a branch of the Veterinary science that deals with housing, breeding, feeding and health care of different domesticated livestock. In other words. it deals with production and protection of different classes of domesticated livestock aiming for maximum economic returns. Major domesticated animals to be considered are: cattle and buffaloes, horse, sheep and goats, pigs, poultry and rabbits including pet animals and wild animals.

Comparatively Veterinary science is a very difficult subject as the animal does not speak and tells its grievances and sufferings however, it sometimes expresses some signals regarding its illness. The Veterinary graduate has to ask the owner regarding the signs and symptoms of suffering animal and examine clinically to identify the suffering and disease of the animal. He has to use all his technical knowledge for proper diagnosis and provide appropriate measures.

**Introduction to Livestock Industry in Nepal**

Livestock is an integral part of the agricultural production system in Nepal providing almost all the draft power for cultivation and dung as farmyard manure to enrich the soil fertility. In the hills and mountain mules, asses, yaks and even sheep and goats are important means of transportation whereas in the Terai bullocks and buffalo bulls are mainly used in pulling cart for transportation of human and other agricultural commodity. Some horses and ponies are also used for transportation. Livestock is the only source of high value animal proteins in the form of milk, milk products, meat and eggs and generates cash income in rural households. Sale of live animals for slaughter, surplus livestock products

and/or draft power accounts over 20 percent of the household cash income. The main reasons for livestock keeping could be ranked as under:

- Manure production
- Draft power production for ploughing and transportation
- Substituting protein rich food for household consumption, and
- Obtaining cash income from selling surplus live animals and their product

Livestock farming is closely inter-related with various components such as crop production, forest, pasture, market and households. The increasing human and livestock population in the country have relentlessly destroyed the forest and pasture for survival and brought most of the marginal land under cultivation which consequently resulted in environmental deterioration, thereby increasing area of degraded forest, denuded hills, soil erosion, shortage of fodder and fuel wood supply.

Livestock productivity is low which is attributed to maintaining indigenous low producing animals, prevailing traditional animal husbandry methods and rising demand of draft power and pack animals, poor nutrition resulting from excessive livestock pressure on available fodder resources and wide range of endemic animal diseases. Livestock feeding depends on seasonally available forage grass, fodder and crop by-products, which are usually inadequate. There is an overall feed deficit as overgrazed areas are increasing in size and livestock owners spending more time in traveling while collecting grasses, fodder and fuel wood.

**Terms used across common farm animals**

| Details | Cattle | Buffalo | Sheep | Goat | Pig | Horse |
|---|---|---|---|---|---|---|
| Species | Bovine | Bovine/ Bubaline | Ovine | Caprine | Swine/ Sus | Equine |
| Group | Herd | Herd | Flock | Flock/ Band | Drove/ Stock | Pack |

| | | | | | | |
|---|---|---|---|---|---|---|
| Adult | Bull | Buffalo | Ram/ | Buck | Boar | Stallion |
| Male | | bull | Tup | | | |
| Adult | Cow | Buffalo | Ewe | Doe | Sow | Mare |
| Female | | Cow/She buffalo | | | | |
| Young | Bull calf | Buffalo | Ram | Bucking/ | Boarling | Colt |
| Male | | bull calf | lamb/Tup lamb | Male kid | | |
| Young Female | Heifer Calf | Buffalo heifer calf | Ewe lamb/ Gimmer lamb | Goatling | Gilt | Filly |
| New born | Calf | Buffalo calf | Lamb | Kid | Piglet/ Pigling | Foal |
| Castrated | Bullock/ | Buffalo | Wether/ | Castrated | Hog/stag/ba | Gelding/ |
| Male | Steer | bullock | Wedder | | rrow | Geld |
| Castrated | Spayed | Spayed | Spayed | Spayed | Spayed | Spayed |
| Female | | | | | | |
| Act of Parturition | Calving | Calving | Lambing | Kidding | Farrowing | Foaling |
| Act of Mating | Serving | Serving | Tapping | Serving | Coupling | Coverin g |
| Gestation | 282 days | 310 days | 151 days | 151 days | 114 days | 336 days |
| Period | | | | | | |

**Common Animal Husbandry Terms**

1. **Nymphomaniac or chronic- buller** A cow affarently always in heat.
2. **Cryptorchid**

   A male animal in which one or both the testicles fail to descend into the scrotal sac.

3 **Free Martin**

When twin calves of different sexes are born, the bull calf is usually sexually normal, but often the heifer calf is sterile. Such female calves are known as Free martin.

4 **Crone**

An old broken mouthed ewe which has been retained in a breeding flock beyond the normal time because of her excellent breeding performance.

5 **Culling**

Removal of unwanted animals from the herd for economic purpose.

6 **Shearing**

The process of removing wool in sheep.

7 **Gimmer**

A female sheep between first and second shearing.

8 **Seggy**

A ram castrated after service.

9 **Open animal**

Female animals that have not been bred.

10 **Card/ Crit/ Runt**

The smallest piglet usually last to be born in farrowing.

11 **Parturation**

Act of giving birth

12 **Fecundity**

The ability or capacity of a female to produce functional ova.

13 **Prolificacy**

Capacity of female to produce more number of offspring.

14 **Jenny**

A female donkey

15 **Jack**

An uncastrated male donkey

16 **Castration**

The process of making animal sterile

17 **Flushing**

Practice of providing extra nutritious diet 3-4 week prior parturition.

18 **Caponization**

The process of castration of male bird.

## 1.2 Zoological Classification of Common Domestic Animals, and Difference between Ruminant and Non Ruminants Animal

| | | Taxonomic Hierarchy |
|---|---|---|
| Bos | Genus | Oxen, true cattle |
| Bovinae | Sub-family | Bovines, including cows, yaks and buffalo |
| Bovidae | Family | Gazelles, African antelope, Buffalo, Mountain goats, and domesticated species such as cattle, sheep, and goats |
| Artiodactyla | Order | Even-toed ungulates eg. pigs, camels, deer and cattle |
| Eutheria | Infra-class | Placental mammals |
| Theria | Sub-class | Mammals that give birth to live young |

| | | |
|---|---|---|
| Mammalia | Class | Egg-laying mammals, live bearing mammals |
| Vertebrata | Sub-phylum | Amphibians, birds, cartilaginous fishes, rays, sharks, mammals, reptiles, cyclostomes, jawless fishes, bony fishes |
| Chordata | Phylum | Animals with a dorsal hollow nerve chord, dorsal supporting rod (notochord), and gill pouches or slits. |
| Animalia | Kingdom | Mammals, fish, insects, birds, humans |

## Exercise

**Choose the correct answer from the given alternatives.**

1. What percentage of Nepal's population is directly dependent on agriculture, including livestock?

   a. 25%  b. 50%

   c. Over 65%  d. 80%

2. Which sector contributes significantly to rural income and food security in Nepal?

   a. Tourism  b. Information Technology

   c. Livestock farming  d. Mining

3. Which of the following is a major livestock species raised in Nepal?

   a. Kangaroo  b. Llama

   c. Yak  d. Camel

4. What is the primary use of buffaloes in Nepal?

   a. Transport  b. Meat and milk production

   c. Guard animals  d. Racing

5. Livestock farming in Nepal is mostly practiced in:

   a. Urban areas

   b. Commercial zones only

   c. Small-scale mixed farming systems

   d. Desert areas

6. What role does livestock play in Nepal's economy?

   a. Increases imports

   b. Reduces employment

   c. Contributes to national GDP and rural employment

   d. Promotes deforestation

7. Which of the following best defines the term "livelihood security"?

   a. Availability of mobile phones

   b. Reliable food, income, and resources to sustain life

   c. Owning luxury items

   d. Stock market investment

8. Which is an example of a dual-purpose livestock breed in Nepal?

   a. Holstein b. Murrah

   c. Local hill goat d. Jersey

9. Which of the following is a by-product of livestock farming that improves crop productivity?

   a. Wool b. Dung/manure

   c. Meat d. Leather

10. What is one key way livestock farming contributes to women empowerment in Nepal?

    a. Reduces workload

    b. Creates space for migration

    c. Increases control over household income

    d. Promotes online education

11. Which of the following livestock contributes most to milk production in Nepal?

    a. Goat b. Chicken

    c. Yak d. Buffalo

12. In Nepal, livestock farming helps reduce:

    a. Rural-to-urban migration b. Food availability

    c. Farm employment d. Crop yield

13. What is the term for the science of breeding and caring for animals?

a. Agronomy b. Pathology

c. Animal Husbandry d. Botany

14. Which term describes the removal of a young animal from its mother's milk?

a. Milking b. Calving

c. Weaning d. Castration

15. What do we call the process of removing reproductive organs to prevent breeding?

a. Clipping b. Shearing

c. Castration d. Branding

## Write short answer to the following questions.

1. What is the current status of livestock farming in Nepal?
2. Name any two major livestock species raised in Nepal.
3. Define animal husbandry.
4. What do you understand by the term "weaning"?
5. What is the role of buffalo in Nepalese farming systems?
6. Name one dual-purpose breed of livestock in Nepal.
7. What is castration and why is it done?
8. Define the term "fodder".

## Write long answer to the following questions.

1. Describe the current status of livestock farming in Nepal. Include types of livestock and farming systems.
2. Discuss the scope and economic importance of livestock farming in improving the livelihoods and food security of rural people.
3. Define key terminologies used in animal husbandry such as weaning, castration, fodder, concentrate, and breeding. Explain their relevance in livestock management.

Unit 2

# Breeds of Animals

## 2.1 Introduction

### a. Breeds of Cattle

The existing two main groups of bovidal are:

- *Bos indicus* (Indian and African cattle: indigenous cattle): eg. Zebu cattle
- *Bos Taurus* (European: exotic cattle): eg. Jersy, Holstein-Friesian, Ayresire and Brownswiss

Indigenous zebu cattle (*Bos indicus*) or humped cattle might have been produced either in south or south west Asia. The zebu is characterized by:

- Presence of prominent large hump
- A long face
- Upright horns
- Drooping ears
- A large dewlap and slender legs

*Bos taurus* found in Europe and North America is all non-humped cattle.

### b. Indigenous Cattle Breeds

Some production and morphological parameters of indigenous breeds of cattle

| buffalo | age at 1st calving (mths) | Calving interval (days) | Milk yield (lits/day) | Adult weight (kg) | | Body length (cm) |
|---|---|---|---|---|---|---|
| | | | | male | female | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Terai | 53 | 410 | 1-1.5 | 250-300 | 150-200 | 107 |
| Pahadi | 50 | 530 | 1.0-1.5 | 200-250 | 120-160 | 102 |
| Lulu | 40-60 | 365-730 | 0.25-2.5 | 150 | 125 | 87 |
| Acchami | 42-60 | 250-480 | 0.5-1.5 | 100-120 | 150 | 90 |
| Siri | 48-55 | 365-547 | 4-6 | 300-350 | 200-300 | 116 |
| Yak | 48-72 | 547-730 | 0.9 | 225-400 | 220-360 | 84 |

**Lulu**

Lulu is a small sized *Bos taurus* cattle found in mountain districts- Manang, Mustang and Dhaulagiri. Colour varies from black to white. Ear is straight with an average length of 14 cm. The calving interval is more than 2 years and calf mortality is high.

**Achhami**

These are mostly found in Accham district of Seti zone. They are popular for high yield in compare to their body weight. Body condition varies from black and white. Ear is straight with an average length of 17cms.

**Siri**

Siri cattle are black and white in colour. Well developed udder and larger than pahadi cattle. They have flat forehead, small ears and sharp horns projecting forward and slightly upward. Body colour varies from black to white i.e black, brown, grey, white, spotted black and white.

**Terai**

It is hump type cattle. It has multipurpose use: milk, manure and draft. Females are poor milk yielders and males are good animals for transport and ploughing the land. Coat color is White or red but mixed color is also available. It is located in Terai region of Nepal and suitable for tropical and subtropical region. The age at first calving is 53 months with calving interval of 1.12 years. Milk yield is

1.0-1.5 liters a day.

**Pahadi**

This is a zebu cattle raised in milk hills of country ranging from 1000-2000 masl. Although, the breed is low milk yielder (460+/- 97 liters per lactation), the cattle are resistant to most disease and external parasites except contagious ones. Body color varies from black to white i.e. black, brown, grey, white, spotted black and white. Males are good draft animals. The age at first calving is 50 months, calving interval is 1.45 years.

**Yak/Nak/Chauri**

The hairy animals are alpine cattle raised from 3000-5000 masl and are found in Nepal, Tibet, Mangolia, Russia and India. Male is called Yak, female-Nak and Crossbred-Chauri, Jhopkyo, Dimjo and Urang. The optimum temperature for maintaining yak is $0^0$C to $10^0$C although yak can thrive far below freezing point. It looses abut 25% summer body weight in winter and early spring due to extreme cold weather and limited available feeds. These animals are popular for producing milk, milk products and meat in the mountains, and castrated males are used for transportation and draft power in the remote mountains. Chanwar has religious value while hair is used to produce ropes and blankets.

Body color varies from black to white. Ear is straight. Tail having swampy switch. Its temperament varies from docile to wild. Generally Nak is not milked for the first two months after calving in order to make its calf healthy. The milk production varies from 220 Kg to 720 Kg in the lactation period of 150-180 days. Total yak/nak population is estimated ot be around 8500 in the Himalayan belt of the country. Their calving interval is about 1.53 +/- 0.48 years.

In Nepal Yak, Nak and Chauri are found in the following districts

Taplejung, Sankhuwasabha, Tehrathum, Bhojpur and Solukhumbu of Koshi Province, Dolakha, Ramechhap, Sindhupalchowk, Rasuwa and Dhading of Bagmati Province, Gorkha, Manang, Baglung and Mustang of Gandaki

Province, Rukum, Dolpa, Jumla, Mugu and Humla of Karnali Province, and Bajura, Bajhang and Darchula of Sudurpashim Province.

### B Exotic Breeds of Cattle

The different exotice breeds of cattle with their production and morphological characteristics are described below:

#### a. Hariyana

- Hariyana is an Indian dual type of cattle characterized for both milk production and drought purpose.
- Bullocks are powerful animals and good for transportation and rapid ploughing. Cows are fairly good milkers

**Distinguishing Characters**

- Small head with long, narrow faces from which emerge short and some what horizontal horns which grow longer and curve upwards and inwards in bullocks.
- Long and compact barrel.
- Legs are sturdy and long with well-shaped hoofs
- Thin and short tail.
- In cows udder is well developed with prominent teats.
- These are generally white or light grey in color**.**
- Average milk production is 5-6 liters per day.

#### b. Sahiwal

- It is a milch breed of cattle. Average milk yield is about 2150 lits in 300 days of lactation period.
- Loose skin (hence named lola), short legs, stumpy horns, broad head.
    - General colors are various shades of red, pale red and dark brown splashed with white.
    - Horns are short and thick, do not exceed 3 inches.

- Massive hump (in male), voluminous dewlap and pendulous sheath.
- Long tail almost reaching to the ground, tapering to a good black switch.
- Navel flap is prominent in female.
- Males weight about 340 kg.

**c. Jersey *(Bos Taurus)***

- It is a dairy cattle originated in Island of Jersey in England.
- It is a good milk yielder having the highest fat percentage.

**Distinguishing Characters**

- Straight top lines, sharp wither.
- Heads have a double dish.
- Coat color generally fawns with or without white markings.
- Can withstand tropical and humid climate more than Holstein-Friesian.
- Animals are inclined to be nervous and sensitive.
- Bulls are often vicious.
- These animals are capable of utilizing roughages efficiently.
- A male weighs about 675 Kg and female weighs about 450 Kg.
- Average milk production is 4000 liters/lactation of 305 days with fat percentage of 5.5.

**d. Holstein (Bos Taurus)**

- It is exotic dairy cattle originated in Holland and is popular for high milk production.

**Distinguishing Characters**

- It is black and white patched, hump less, comparatively big animal having long leg with large feeding capacity and udders.

- Head is long, narrow and straight with slightly rounded withers.
- A male weighs about 1000 Kg and females weigh about 675 Kg.
- Average milk productions is about 6150 liters/lactation of 305 days with 3.5 fat percentage.

**e. Ayrshire *(Bos Taurus)***

- It is regarded as hardy breed of dairy cattle, originally found in Ayrshire, a county of Scotland.
- It is slightly bigger than Jersey and smaller than Holstein.

**Distinguishing Characters**

- Straight top lines and good udders.
- Long horns which are turned upwards.
- They have shorter and thicker neck in comparison to other breeds.
- Animals are over active and difficult to manage.
- A male weighs about 850 kg and female Weighs about 550 Kg.
- Average milk productions is 4840 liters per lactation of 305 days with 4.1% fat.

**f. Brown Swiss *(Bos Taurus)***

- This is also an exotic breed of cattle introduced mainly to upgrade Nak and local cows of hills and mountain districts.
- This breed is mostly concentrated in Dolakha district as it is farmed at Jiri livestock farm.
- It is a multipurpose breed and originated in Switzerland. Breed is used for transportion, milk and beef in Switzerland.

**Distinguishing Characters**

- Large heads, which are usually dished and thick loose skin.
- Animals are not angular as those other dairy breeds. Quite docile and

easily manageable. More heat tolerant than Jersey. A male weighs about 900 Kg and female weighs about 625 Kg.

- An average milk production is 5250 liters/lactation of 305 days with 4.1 fat percentages.

### C. Indigenous Buffalo Breeds

There are three indigenous breeds of buffalo in the country that have been identified and characterized so far. Among them gaddi is the largest and lime is the smallest. They are lime, parkote and gaddi. All identified indigenous buffaloes in the country are riverine with 25 pairs of chromosomes.

Some production and morphological parameters of indigenous breeds of buffalo

| Parameters | Lime | Parkote | Gaddi |
|---|---|---|---|
| Age at 1st calving(yrs) | 5 | 5 | 5 |
| Calving interval(month) | 20 | 20 | |
| Milk yield(l/day) | 2-3 | 2-3 | 2-4 |
| Adult weight(kg) | 300-325 | 325-350 | 375-450 |
| Body weight(cm) | 125cm | | 141cm |
| Wither height(cm) | 118 | 124 | 131 |

**Lime**

- Found in low mid hills and are average milk yielders.
- Grey in colour. The skin colour shades from whitish brown to grey.
- Eye brows are brown.
- Has a typical character with a chevron of grey or white hairs below the jaw and around the brisket.
- Has a whitish colour as the leg markings below the knee.
- Small sickle shaped horns curved towards the neck.

**Gaddi**

- Black colour with white round patches on forehead.
- Long face and flat head
- Horns- long half curved
- Found in the far western hills

**Parkote**

- Scattered from low to high hills, found predominantly in the mid hills
- Long face and flat head
- Horns are sword shaped directed towards the back of the body
- Temperament is semiwild

**D. Exotic Breeds of Buffalo**

**a. Murrah**

- **Origin:** Punjab, Haryana and Union territory of Delhi (India)
- Noted for milk production. Average lactation yield is 1400-1800 liters with a fat percentage of 7.0 in a lactation period of 9-10 months.

**Distinguishing Characters**

- Small and clean head. Forehead slightly prominent.
- Short horns, flat and turning backwards, upwards and curling inwards in a spiral form.
- Body massive, long and deep. Prominent well developed udder and good sized teats.
- Long tail with white switch reaching to the fetlock.
- Adult weight is about 400-450 kg.
- Popular coat color is jet black with white markings on tail, face and extremities.

**b. Jaffarabadi**

- Origin: Located in the purest form in the Gir forest of Kathiawar especially towards Jaffarabadi in India. Heavy milkers.

**Distinguishing Characters**

- Heavy head, bulging and prominent forehead.
- Broad, flat horns droppings on each side of the neck and turning up at the points with a loose curve.
- Body is wedge shaped.
- Udder is large and well developed.
- Usually black in color, with white patches on face and legs.

**c. Nili Ravi**

- Origin: Montgomeri district of West Pakistan and Ferozepore district of Punjab

**Distinguishing Characters**

- Heavy body. Males are commonly used for heavy draft and females are heavy milkers.
- The average milk is 1600 liters in a lactation period of 250 days.
- The usual color is black with white markings on forehead, face, muzzle, legs and switch.
- Tail is long, almost touching the ground.

## Exercise

**Choose the correct answer from the given alternatives.**

1. Which of the following is an indigenous breed of cattle in Nepal?
   a. Jersey
   b. Holstein
   c. Red Chittagong
   d. Sahiwal

2. Which exotic breed of buffalo is known for high milk production?
   a. Murrah
   b. Jaffarabadi
   c. Nili-Ravi
   d. Surti

3. Which breed of goat is indigenous to Nepal?
   a. Boer
   b. Jamnapari
   c. Chyangra
   d. Alpine

4. Which exotic breed of sheep is commonly raised for wool production?
   a. Hampshire
   b. Merino
   c. Blackface
   d. Jacob

5. What is the primary purpose of breeding the Large White pig?
   a. Meat production
   b. Milk production
   c. Fur production
   d. Both meat and fur production

6. Which rabbit breed is considered an exotic breed in Nepal?
   a. New Zealand White
   b. Nepali White
   c. Angora
   d. Rex

7. Which indigenous poultry breed in Nepal is known for its resistance to diseases?
   a. Rhode Island Red
   b. Leghorn
   c. Kathmandu Chicken
   d. Plymouth Rock

## Write short answer to the following questions.

1. Name indigenous cattle breeds found in Nepal.
2. What is the main difference between indigenous and exotic livestock breeds?
3. Mention exotic breed of buffalo.
4. Which goat breed is known for producing high-quality wool in Nepal?
5. What is the primary purpose of raising the Large White pig?
6. List any indigenous breeds of sheep in Nepal.
7. Name exotic poultry breeds commonly raised in Nepal.
8. What are the key characteristics of the Jersey cow breed?
9. Why is the Murrah buffalo considered a good breed for dairy farming?

## Write long answer to the following questions.

1. Describe the differences between indigenous and exotic cattle breeds. Provide examples of each and discuss their advantages and disadvantages.
2. Explain the characteristics and advantages of the Murrah buffalo breed and its importance to Nepalese dairy farming.
3. Discuss the importance of indigenous goat breeds in Nepal and their role in the livestock economy.
4. Compare the indigenous and exotic breeds of pigs, and explain how these breeds are suited to the Nepalese farming system.

# Care and Management of Animals

Unit 3

**Introduction**

The art and science of combining ideas, facilities, processes, materials and labor to produce and market a worthwhile product or services successfully is management. Success in dairying depends largely on the proper care and efficient management of the herd. Animal care and management refers to the processes and practices used to ensure the well-being and proper management of animals in a domestic, agricultural, or wildlife setting. It includes everything from feeding and health care to housing and behavior management and breeding. Animals need to be cared for to not only be healthy and safe but also be productive, such as in the case of livestock farms, we need these animals to thrive in their environments.

## 3.1 Care and Management of Milking Cattle and Buffalo, Dry Cattle and Buffalo, Pregnant Cattle and Buffalo, Newly Born Calves, Heifers

### 3.1.1 Care and Management of Milking Cattle and Buffalo

**Feeding**

- Feed should meet the animal's maintenance and production needs. Provide

  green fodder, dry fodder (straw/hay), and concentrates depending on the

  milk yield.
- For every liter of milk, provide about 1 kg of concentrate feed.
- Supply mineral mixtures and salt to maintain health and fertility.

- Provide clean drinking water at all times—milking animals need a large amount of water.

**Milking Management**

- Milking should be done twice daily at fixed times, using clean hands.

**Sanitized Equipment**

- Wash the udder and teats with warm water before milking and dry with a clean cloth.
- Avoid loud noises or rough handling to prevent stress, which can reduce milk letdown.

**Housing**

- Milking animals should be housed in a clean, dry, well-ventilated shed with adequate space.
- The floor should be non-slippery and slightly sloped for drainage.
- Ensure regular cleaning and use of disinfectants to prevent diseases.

**Health Management**

- Maintain a vaccination schedule for FMD, HS, and other local diseases.
- Deworm animals every 3–6 months.
- Monitor for mastitis, lameness, and reproductive disorders.

### 3.1.2 Care and Management of Dry Cattle and Buffalo

The dry period (typically 60 days) is crucial for recovery and preparation for the next lactation.

**Feeding**

- Reduce concentrate feed but provide good quality roughage.
- Supplement with minerals to maintain body condition and support fetal growth.
- Avoid overfeeding to prevent fat accumulation, which may cause calving problems.

**Housing and Management**

- Provide clean, dry, and peaceful housing separate from milking animals.
- Ensure access to shade and exercise areas.

**Health**

- Deworm before drying off.
- Vaccinate during the dry period (e.g., Brucellosis vaccine, FMD booster, etc.).
- Monitor body condition to avoid underweight or overweight animals at calving.

### 3.1.3 Care and Management of Pregnant Cattle and Buffalo

Especially in the last trimester, careful management ensures healthy calf development and smooth calving.

**Feeding**

- Provide high-quality forage, limited concentrates, and mineral supplements.
- In the last 2 months, increase energy and protein to meet fetal growth demands.
- Feed small, frequent meals to avoid digestive problems.

**Housing and Management**

- Use maternity pens for the last few weeks of gestation.
- Ensure soft bedding and a quiet environment to reduce stress.
- Observe daily for signs of approaching calving (swollen vulva, udder enlargement, restlessness).

**Health**

- Vaccinate for Brucellosis, FMD, HS, and Black Quarter at recommended times.

- Deworm safely before the last month of gestation.

### 3.1.4. Care and Management of Newly Born Calves

**At Birth**

- Clear mucus from the mouth and nostrils immediately to ensure breathing.
- Tie and cut the navel cord, then disinfect with tincture of iodine to prevent infection.

**Colostrum Feeding**

- Feed colostrum within the first 1–2 hours and continue for at least 3 days.
- Colostrum provides essential antibodies, nutrients, and digestive support.

**Feeding after Colostrum**

- Start with whole milk or milk replacer.
- Introduce calf starter feed by 1–2 weeks and roughage by 3–4 weeks.
- Provide clean water from the second week onward.

**Housing**

- Keep calves in individual or group pens that are clean, dry, and warm.
- Avoid direct wind or cold; use bedding like straw or sawdust.

**Health**

- Follow a vaccination and deworming schedule.
- Monitor daily for signs of diarrhea, navel infection, or pneumonia.

### 3.1.5. Care and Management of Heifers (Growing Female Calves)

Heifers are future milking animals and must be raised with attention to growth and reproductive health.

**Feeding**

- Provide a balanced diet of roughage and concentrates to support growth without making the heifer fat.
- Use mineral mixtures to prevent deficiencies affecting reproduction.

**Housing and Management**

- Provide adequate space and access to exercise to promote bone and muscle development.
- Keep them in separate pens to avoid bullying by older animals.

**Breeding Management**

- Monitor for signs of estrus from 12–15 months of age.
- Breed at 18–24 months when the heifer reaches about 65–75% of adult body weight.
- Avoid early or late breeding, which can cause reproductive and calving problems.

**Health**

- Vaccinate regularly (FMD, HS, Brucellosis).
- Deworm every 3–4 months.
- Keep records of growth, heat signs, and health treatments.

## 3.2 Care and Management of Pregnant and Lactating Doe, Care of Doe after Kidding, Care of Newly Born Kids, Care of Young Stocks, Care of Breeding Buck.

### 3.2.1 Care and Management of Pregnant Doe

**Feeding**

- Provide balanced nutrition with adequate green fodder, dry fodder, and concentrate (especially during the last 6–8 weeks of gestation).
- Ensure mineral mixture and clean water availability.
- Avoid sudden changes in feed to prevent digestive upsets.

**Housing**

- Keep in clean, dry, and well-ventilated sheds.
- Separate pregnant does from the main herd, especially in the last month.
- Provide soft bedding to prevent injury.

**Health Management**

- Vaccinate for common diseases (e.g., Enterotoxemia, PPR, CDT).
- Deworm during the second trimester with safe dewormers.
- Monitor for signs of illness and observe for signs of nearing kidding (restlessness, udder swelling, vulva softening).

### 3.2.2 Care and Management of Lactating Doe

**Feeding**

- Increase the energy and protein content to support milk production.
- Provide quality leguminous fodder and about 300–500g concentrate feed per day.
- Continue mineral supplementation and clean drinking water.

**Milking and Hygiene**

- Milk twice daily at regular times.
- Clean udder and teats before and after milking to prevent mastitis.
- Ensure a stress-free environment during milking.

### 3.2.3 Care of Doe after Kidding

**Immediate Post-Kidding Care**

- Allow the mother to lick the kid to promote bonding and stimulate circulation in the kid.
- Clean the doe's vulva and hindquarters with warm water and antiseptic solution.
- If placenta does not come out within 12 hours, seek veterinary help.

**Feeding**

- Provide warm bran mash or light gruel for the first 1–2 days.
- Gradually return to the regular lactating diet.
- Ensure mineral and vitamin supplements to aid recovery.

**Health Monitoring**

- Observe for postpartum complications like retained placenta, prolapse, or infections.
- Deworm and vaccinate if not done during pregnancy.

### 3.2.4 Care of Newly Born Kids

**At Birth**

- Clear mucus from the nose and mouth.
- Disinfect the navel cord with tincture of iodine.
- Ensure the kid stands and nurses within 30 minutes to 1 hour.

**Colostrum Feeding**

- Feed colostrum within the first 1–2 hours and for at least 3–5 days.
- Colostrum is rich in antibodies and nutrients.

**Housing**

- Keep kids in a warm, dry, and draft-free area.
- Provide clean bedding and protect from cold, rain, and predators.

**Health**

- Vaccinate (e.g., CDT at 1.5–2 months).
- Watch for diarrhea, pneumonia, navel ill, and other infections.

### 3.2.5 Care of Young Stocks

**Feeding**

- Start offering creep feed and soft fodder from 2–3 weeks of age.

- Gradually wean at 2–3 months.
- Provide a balanced diet for proper growth and development.

**Housing**

- Keep in groups by age and size to avoid competition.
- Maintain clean and dry housing with adequate space.

**Health and Management**

- Regular deworming every 1–2 months.
- Follow a vaccination schedule.
- Monitor weight gain and record growth for breeding and selection.

### 3.2.6 Care of Breeding Buck

**Feeding**

- Provide high-quality fodder and concentrate during the breeding season.
- Avoid overfeeding to prevent obesity.
- Supplement with minerals and vitamins, especially zinc and selenium, for fertility.

**Housing**

- Keep in separate pens to prevent fighting.
- Provide exercise space to maintain physical condition.

**Health Care**

- Deworm regularly.
- Vaccinate and maintain hoof trimming and grooming.
- Avoid overuse during the breeding season (limit to 2–3 services/day).

**Breeding Management**

- Start using bucks for mating from 8–10 months of age.
- Use each buck with 20–30 does per breeding season.

## 3.3 Care and Management of Pregnant andLactating Ewe, Care of Ewe after Lambing, Care of Newly Born Lamb, Care of Young Stocks.

### 3.3.1 Care and Management of Pregnant Ewe

**Feeding**

- During early pregnancy, feed maintenance diet with good-quality roughage and a small amount of concentrate.
- In the last 6–8 weeks of pregnancy, increase energy and protein by feeding concentrates, green fodder, and mineral supplements.
- Ensure clean drinking water is always available.

**Housing**

- Provide dry, clean, well-ventilated housing with soft bedding.
- Avoid overcrowding; keep pregnant ewes in separate pens especially in the last month.
- Prevent jumping, slipping, and stress.

**Health Care**

- Vaccinate against Enterotoxemia, Clostridial diseases, and other region-specific infections.
- Deworm with safe anthelmintics during the second trimester.
- Monitor for signs of pregnancy toxemia or abortion.

### 3.3.2 Care and Management of Lactating Ewe

**Feeding**

- Provide a high-energy and protein-rich diet (green fodder + dry fodder + concentrates).
- Feed mineral mixture to support lactation and prevent deficiencies.
- Offer fresh water multiple times a day.

**Housing**

- Maintain hygiene in the shed to prevent mastitis and other infections.
- Ensure enough space and protection from harsh weather.

**Health**

- Monitor for mastitis, lameness, and metabolic disorders.
- Continue a deworming schedule and regular health checks.

### 3.3.3 Care of Ewe After Lambing

**Immediately After Lambing**

- Allow the ewe to lick and clean the lamb to stimulate bonding and\ circulation.
- Remove and properly dispose of the placenta.
- Wash the ewe's hindquarters and udder with lukewarm antiseptic water.

**Feeding**

- Offer warm gruel or bran mash to help recovery.
- Resume normal lactation diet gradually within a few days.
- Provide adequate clean water and minerals.

**Health Care**

- Observe for retained placenta, uterine infections, or postpartum complications.
- If required, administer vitamin and mineral supplements.
- Keep records of lambing date and ewe condition.

### 3.3.4 Care of Newly Born Lamb

**At Birth**

- Clear mucus from nostrils and mouth to ensure breathing.
- Disinfect the navel cord with iodine to prevent infection.

**Feeding**

- Ensure the lamb receives colostrum within the first 30–60 minutes of birth, and continue for at least 3 days.
- Colostrum provides essential immunity and energy.

**Housing**

- Keep lambs in a warm, dry, and draft-free pen (especially in cold areas).
- Provide bedding like dry straw and keep it clean.

**Health**

- Monitor for diarrhea, weakness, or hypothermia.
- Start creep feeding at 2–3 weeks of age.
- Begin vaccinations (e.g., CDT) and deworming as per vet advice.

### 3.3.5 Care of Young Stocks.

**Feeding**

- After weaning (around 8–10 weeks), feed a balanced diet with concentrates, green fodder, and dry fodder.
- Ensure continuous access to clean drinking water and mineral mixture.

**Housing**

- Group lambs by size/age to prevent competition.
- Maintain clean, dry, and spacious shelters.

**Health and Growth Monitoring**

- Deworm every 1–2 months.
- Follow a vaccination schedule (as per local diseases).
- Monitor weight gain and general health regularly.

## 3.4 Care and Management of Pregnant and Lactating Gilt and Sow, Care of Sow and Gilt after Furrowing, Care of Newly Born Piglets, Care and Management of Boar and Young Stocks.

### 3.4.1 Care and Management of Pregnant Sow

**Feeding**

- Feed a balanced ration with 12–14% crude protein and adequate energy.
- During early pregnancy (first 2 months), feed 2–2.5 kg/day.
- In late pregnancy (last month), increase to 2.5–3 kg/day with added minerals (especially calcium and phosphorus).
- Provide clean drinking water always.

**Housing**

- Provide clean, dry, and well-ventilated pens with non-slippery floors.
- Avoid overcrowding and provide separate pens for pregnant sows/gilts.
- Allow light exercise to prevent constipation and farrowing problems.

**Health Management**

- Deworm during mid-pregnancy.
- Vaccinate against common diseases (Swine Fever, FMD, Parvo virus).
- Monitor for signs of farrowing (restlessness, nesting behavior, swollen vulva).

### 3.4.2 Care and Management of Lactating sow and Gilt

**Feeding**

- Increase feeding gradually after farrowing.
- Feed 3–6 kg/day, depending on litter size (1 kg of feed per 1 liter of milk produced).
- Use lactation-specific feed with high protein and energy.
- Provide plenty of clean water to support milk production.

**Health and Housing**

- Keep pens dry, clean, and free from drafts.
- Check for signs of mastitis, metritis, or agalactia (lack of milk).
- Maintain good hygiene of udder and farrowing area.

### 3.4.3 Care of Sow and Gilt after Farrowing

**Immediately After Farrowing**

- Remove placenta and afterbirth to keep the pen clean.
- Offer warm bran mash or gruel to ease digestion.
- Ensure sow is calm and rested, and avoid stress.

**Feeding and Monitoring**

- Feed small quantities for the first 24 hours.
- Gradually increase the quantity based on appetite and milk output.
- Monitor for fever, infection, and udder health.

### 3.4.4 Care of Newly Born Piglets at Birth

- Wipe mucus from nose and mouth.
- Disinfect navel cord with iodine solution.
- Make sure piglets are suckling within 30 minutes to get colostrum.

**Temperature Management:**

- Keep piglets warm (ideally 30–32°C).
- Use heat lamps or heating pads in cold weather.

**Routine Practices**

- Clip needle teeth to prevent injury.
- Dock tails to reduce tail-biting.
- Iron injections (100–200 mg IM) at 3–5 days to prevent anemia.
- Castrate males not needed for breeding at 7–14 days.

### 3.4.5. Care of Young Stocks (Weaners and Growers)

**Weaning**

- Wean at 3–5 weeks of age.
- Feed creep feed from 2 weeks of age.
- After weaning, provide starter ration with 18–20% protein.

**Housing and Management**

- House by size and age to avoid bullying.
- Keep pens clean and dry, avoid overcrowding.

**Health**

- Regular deworming and vaccinations.
- Monitor for signs of diarrhea, respiratory disease, or poor growth.

### 3.4.6. Care and Management of Boar

**Feeding**

- Feed 2.5–3.5 kg/day of a boar-specific ration with 14–16% protein.
- Avoid overfeeding to prevent obesity.

**Housing**

- Keep in individual pens with space for exercise.
- Maintain clean and dry housing to avoid foot and leg problems.

**Breeding Management**

- Start using boars at 8–9 months of age.
- Do not allow more than 1–2 matings/day to avoid exhaustion.
- Ensure rest and good nutrition during non-breeding periods.

**Health**

- Regular health check-ups, deworming, and vaccinations.
- Monitor for signs of lameness or reproductive problems.

## Exercise

**Choose the correct answer from the given alternatives.**

1. What is the ideal daily water intake for a lactating cow or buffalo?
   a. 10–20 liters
   b. 20–30 liters
   c. 50–70 liters
   d. 80–100 liters

2. What is the purpose of drying off a cow before calving?
   a. To reduce feed cost
   b. To improve milk quality
   c. To allow udder tissue to regenerate
   d. To prevent the calf from suckling

3. Newborn calves must receive colostrum within how many hours of birth?
   a. 1 hour
   b. 6 hours
   c. 24 hours
   d. 48 hours

4. Heifers should be bred for the first time at what age?
   a. 6 months
   b. 12 months
   c. 18–24 months
   d. 30 months

5. When should colostrum be given to a newborn kid?
   a. After 12 hours
   b. Within 2 hours
   c. On the second day
   d. Not required

6. Which nutrient is most critical during lactation in does?
   a. Fiber
   b. Protein
   c. Fat
   d. Vitamin C

7. How often should a breeding buck be dewormed?
   a. Once in a lifetime
   b. Monthly
   c. Every 3–4 months
   d. Daily

8. What is the usual weaning age for kids?

a. 1 month b. 2 months

c. 3 months d. 6 months

9. What is the most common cause of lamb mortality in the first week?

a. Pneumonia b. Heat stroke

c. Starvation and hypothermia d. Bloat

10. How soon should a lamb start be suckling colostrum?

a. Within 1 hour b. After 12 hours

c. After 24 hours d. After 2 days

11. What is the ideal protein content of feed for growing lambs?

a. 8% b. 12% c. 16–18% d. 24%

12. Pregnant ewes should be separated for lambing approximately how many days before due date?

a. 1–2 days b. 3–4 days

c. 7–10 days d. 20 days

13. When should iron injection be given to piglets to prevent anemia?

a. At birth b. 3–5 days after birth

c. 15 days after birth d. After weaning

14. What is the ideal temperature for newborn piglets?

a. 15°C b. 20°C c. 30–32°C d. 40°C

15. At what age should piglets be weaned?

a. 1 week b. 2 weeks

c. 3–5 weeks d. 8–10 weeks

16. How many matings per week should a mature boar be allowed?

a. 1–2 times b. 3–4 times c. 5–6 times d. Daily

## Write short answer to the following questions.

1. What is the importance of feeding colostrum to newborn calves?
2. Why is drying off necessary before calving in dairy cattle or buffalo?
3. What care should be given to a lactating cow to ensure high milk production?
4. Mention two management practices for pregnant cows or buffaloes.
5. At what age should heifers be bred for the first time?
6. List two important care practices for a pregnant doe.
7. What should be done immediately after a doe gives birth?
8. How can the body temperature of piglets be maintained after birth?
9. What are the feeding needs of a lactating sow?

**Write long answer to the following questions.**

1. Describe in detail the care and management practices for milking cattle and buffalo to maintain health and increase milk production.
2. Explain the management practices for dry, pregnant, and lactating cattle and buffalo. How do these practices impact reproductive efficiency?
3. Discuss the importance of colostrum and the care of newly born calves. How should heifers be raised to become productive dairy animals?
4. Explain the proper care of a pregnant and lactating doe. What management is required after kidding to ensure health of both mother and kid?

Unit 4

# Farm Management

**Introduction**

The study of farm management is crucial and central to the whole discipline of agricultural economics. Agricultural economics involves the application of economic principles in agriculture. One of the important branches of agricultural economics is farm management.

Farm management comprises of two words; farm and management. Farm can be defined as a piece or pieces of land operated as single unit of agriculture enterprise under one management". 'Management means the act or art of managing. According to Gray, the art of managing a farm successfully, as measured by the test of profitableness, is called farm management. Farm Management is the decision making process whereby limited resources are allocated to a number or production alternatives to organise and operate the business in such a way as to attain some objectives.

Farm management is a branch of agricultural economics, which helps to coordinate the limited scarce resources such as land, labor, capital and management with their alternative uses on farm in order to achieve the specific goals of continuous maximum profit of satisfaction as regular basis.

Farm management is a rational resource allocation proposition more particularly from the point of view of an individual farmer. On the one hand, a farmer has a certain set of farm resources such as land, labor, farm buildings, working capital, farm equipments etc; that are relatively scarce. On the other side, the same farmer has a set of goals or objectives to achieve, may be maximum family satisfaction through increasing net farm income.

Farm Management is a science, which deals with proper combination and operation of production factors including land, labour and capital. In this age of science and technology, success in business requires ability to harness scientific and technical knowledge. It involves having a personal command and clear hold on the technological, commercial and human aspects of business, which become interwoven into successful progress in business.

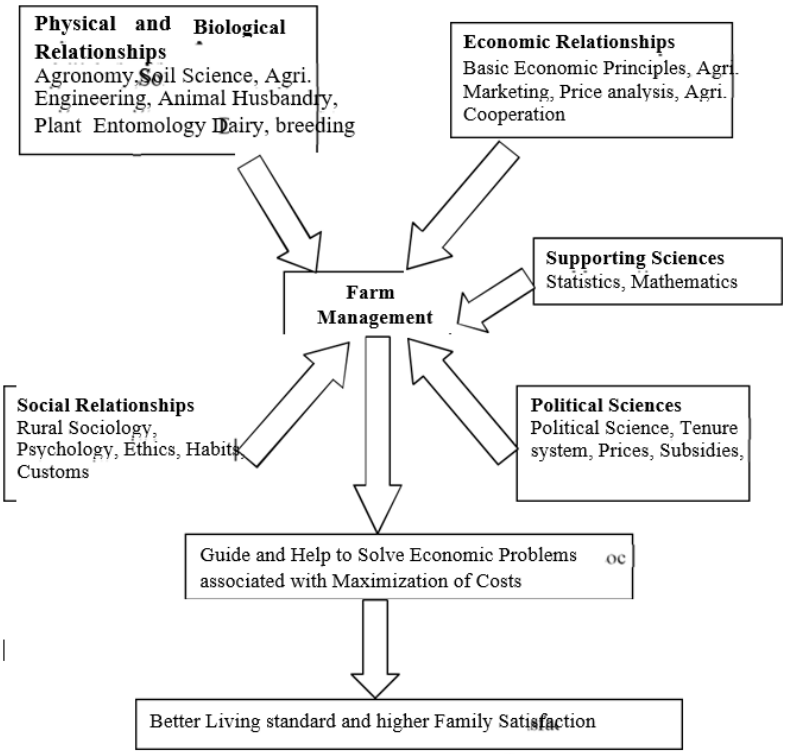



**Fig: Relationship of farm management with other scien**

Farm Management Practices such as Disinfection, Isolation, Quarantine, and Carcass Disposal

Farm management includes the practice of disinfection, isolation, quarantine, and carcass disposal which are critical for maintaining the health of livestock and preventing the spread of disease. Here's a detailed discussion of each of these practices:

## 1. Disinfection

Disinfection is an essential farm management practice aimed at reducing the presence of pathogens, bacteria, viruses, and other harmful microorganisms on the farm. This process helps to control disease outbreaks and maintain the health of both animals and farm workers.

- **Purpose**: Disinfection is used to kill or inactivate pathogens on surfaces, equipment, vehicles, and even the farm environment.
- **Methods**: Common disinfectants used on farms include bleach, iodine-based products, formaldehyde, and other specialized veterinary disinfectants. These are applied to the areas like barns, equipment, feed storage, and footpaths.
- **Frequency**: Disinfection should be carried out regularly, especially after animal handling, after an outbreak of disease, or when new animals are introduced to the farm. High-risk areas such as slaughter houses or veterinary treatment rooms may require more frequent disinfection.

## 2. Isolation

Isolation involves separating animals that are suspected to be infected with a contagious disease from healthy animals to prevent disease transmission.

- **Purpose**: The goal of isolation is to limit the spread of disease within the farm. It is particularly important when new animals are introduced to the farm or if an animal shows signs of illness.
- **Method**: Animals that are sick, newly introduced, or coming from another farm should be kept in a separate area away from the healthy population. Isolation should be for a certain period, usually 14–21 days, to monitor the animal for signs of disease.
- **Benefit**: This practice helps prevent the spread of infectious diseases, such as foot-and-mouth disease, avian influenza, or other contagious animal diseases.

### 3. Quarantine

Quarantine is a more stringent form of isolation and is typically used when animals are introduced from outside the farm or when there's a suspicion of disease. The purpose is to prevent an outbreak before it happens.

- **Purpose**: Quarantine ensures that newly introduced animals do not bring in diseases that could affect the existing herd. It's also crucial if the farm has experienced an outbreak or if animals have been exposed to a disease elsewhere.
- **Method**: Animals that are new to the farm or have been in contact with potentially infected animals should be kept in a controlled environment away from other livestock. Veterinary checks, testing for diseases, and monitoring for any clinical signs are carried out during the quarantine period.
- **Duration**: The duration of quarantine can vary depending on the risk of disease and the time required for monitoring and testing. For example, high-risk animals might be quarantined for several weeks, while lower-risk animals may need only a shorter period.

### 4. Disposal of Carcass

Proper disposal of animal carcasses is a vital management practice for controlling disease, preventing environmental contamination, and reducing the risk of zoonotic diseases (those that can be transmitted from animals to humans).

- **Purpose**: Carcass disposal helps prevent the spread of diseases that could potentially contaminate the farm environment or affect other animals. It also ensures that the carcass doesn't pose a health risk to humans, wildlife, or the surrounding ecosystem.
- **Methods**: Common disposal methods include:
    - **Rendering**: The carcass is processed at high temperatures to create products like animal feed or fuel.

- **Composting**: A natural method where carcasses are decomposed by microbes and converted into compost, which can then be used to fertilize soil.
- **Burial**: Carcasses are buried in a properly designated, secure location away from water sources. It's important to ensure that the burial site is deep enough and isolated from surface water to prevent contamination.
- **Incineration**: In certain cases, particularly with highly infectious diseases, incineration of carcasses at high temperatures ensures complete destruction of pathogens.

Local regulations and guidelines often dictate the most appropriate disposal methods, and these should be strictly followed.

- **Precautions**: In the case of an outbreak of contagious diseases like BSE (Bovine Spongiform Encephalopathy) or avian flu, special care must be taken to prevent any risk of infection during carcass disposal. Disposal areas must be kept secure to prevent access by scavengers.

**Why These Practices Matter**

1. **Disease Control**: All of these practices are designed to prevent the spread of infectious diseases such as foot-and-mouth disease, avian influenza, or tuberculosis, which can devastate livestock populations and lead to significant financial losses.
2. **Biosecurity**: By implementing proper disinfection, isolation, quarantine, and carcass disposal measures, farms can maintain a higher level of biosecurity, ensuring that diseases are less likely to be introduced or spread.
3. **Public Health**: Effective disposal of carcasses reduces the potential for zoonotic diseases (such as mad cow disease or avian flu) to spread from animals to humans.
4. **Animal Welfare**: These practices help ensure that animals are not exposed to disease and that they are cared for in a safe, controlled environment,

which improves overall animal welfare and productivity.

By combining these management practices, farm operators can mitigate risks, maintain healthy herds, and promote sustainability in animal agriculture.

## Exercise

**Choose the correct answer from the given alternatives.**

1. Which of the following is a key benefit of efficient resource utilization in farm management?
   a. Increasing land area
   b. Reducing labor requirements entirely
   c. Reducing waste and cost
   d. Eliminating the need for budgeting

2. Farm management helps in maximizing productivity and profit by.....
   a. Buying more animals without planning
   b. Using outdated farming tools
   c. Implementing proper planning and decision-making
   d. Avoiding the use of farm records

3. What role does farm management play in animal health and welfare?
   a. Reduces the need for sanitation
   b. Avoids the need for vaccinations
   c. Supports practices like proper nutrition and housing
   d. Encourages free roaming of all animals

4. Which of the following is NOT a result of effective farm management?
   a. Enhanced decision-making
   b. Reduced risk of disease
   c. Increased unpredictability
   d. Improved sustainability

5. Sustainability in farm management means.....
   a. Producing more animals in less space

b. Avoiding new farming technologies

c. Protecting the environment for long-term productivity

d. Focusing only on short-term profits

6. What is the main purpose of disinfection on a farm?

a. To increase the temperature in animal shelters

b. To make animals immune to all diseases

c. To kill or inactivate pathogens on surfaces and equipment

d. To improve the taste of animal feed

7. How often should disinfection be done in high-risk areas on a farm?

a. Once a year

b. Rarely, only during outbreaks

c. Only after all animals have been sold

d. Regularly, especially after handling animals or disease outbreaks

8. Isolation is primarily used to.....

a. Increase the population of animals

b. Improve breeding performance

c. Separate potentially sick animals from healthy ones

d. Train animals for specific tasks

9. What is the difference between isolation and quarantine?

a. Quarantine is shorter than isolation

b. Isolation is used for healthy animals only

c. Quarantine is more stringent and used when animals come from outside or face disease exposure

d. Isolation involves full-time veterinary care

10. A key reason for quarantining new animals is to.....

    a. Train them before mixing with the herd

    b. Ensure they don't carry diseases into the farm

    c. Increase their productivity

    d. Make them familiar with farm routines

11. What is one of the safest methods to dispose of highly infectious animal carcasses?

    a. Feeding them to other animals

    b. Burying them in shallow pits

    c. Incineration at high temperatures

    d. Leaving them in open fields

12. What is a major public health reason for proper carcass disposal?

    a. To maintain soil fertility

    b. To reduce the spread of zoonotic diseases

    c. To create compost quickly

    d. To lower food costs

13. Which of the following is a benefit of implementing disinfection, isolation, quarantine, and carcass disposal?

    a. Reduced need for veterinary services

    b. Complete elimination of diseases

    c. Improved farm biosecurity

    d. Decrease in animal productivity

## Write short answer to the following questions.

1. What is the main goal of efficient resource utilization in farm management?
2. How does farm management help increase farm profitability?

3. Name two practices that improve animal health and welfare on a farm.
4. How does farm management help reduce risks and losses?
5. What is the primary purpose of disinfection on a farm?
6. Mention two common disinfectants used in farm disinfection.
7. When should disinfection be carried out on a farm?
8. What is isolation in farm management?
9. Why is isolation important when introducing new animals to a farm?
10. How long should animals typically be isolated for observation?
11. Define quarantine in the context of farm management.

## Write long answer to the following questions.

1. Describe how farm management practices promote animal health and welfare. What role do housing, nutrition, sanitation, and vaccination play in this process?
2. How does farm management help in reducing potential risks and economic losses? Include in your answer the role of disease control and risk assessment.
3. Define disinfection in the context of farm management. What are its main purposes, common disinfectants used, and the areas where it should be applied?
4. Discuss the importance of regular disinfection on a farm. When should disinfection be performed, and why is it particularly crucial in high-risk areas?

# Unit 5

# Introduction to Fodder Production

## 5.1 Introduction to Fodder Production

Fodder production refers to the cultivation and management of forage crops primarily used to feed livestock. As livestock farming intensifies, ensuring a year-round, cost-effective, and nutritious feed supply becomes vital. Fodder not only meets the animals' nutritional needs but also improves productivity in terms of milk, meat, and draught power. In Nepal and many developing countries, fodder production is increasingly important due to land scarcity, overgrazing, and the need to reduce feed costs.

Livestock plays a critical role in the livelihoods of rural communities across the world, providing milk, meat, draught power, manure, and income. However, one of the major constraints in livestock productivity is the lack of adequate, nutritious, and affordable feed throughout the year. Fodder production, which involves the cultivation and management of forage crops, is an essential component of sustainable livestock farming. It ensures the availability of green and conserved feed resources necessary for optimal animal health, productivity, and welfare.

Traditionally, many farmers depend on open grazing, crop residues, and limited natural pastures to feed their animals. However, these sources are often seasonal, poor in quality, and insufficient to meet the dietary requirements of modern high-yielding livestock breeds. Overgrazing and deforestation further degrade rangelands, resulting in lower feed availability and environmental damage. As such, there is a growing need to shift from extensive grazing systems to more intensive and planned fodder cultivation practices.

Fodder production includes the growing of grasses, legumes, trees, shrubs, and

crop residues which are harvested and used as animal feed in fresh or preserved form. It involves seasonal planning, the use of improved varieties, and scientific agronomic practices like fertilization, irrigation, weed control, and proper harvesting. The production can be done on-farm using arable land, on bunds or fallow land, or even through intercropping systems that complement food crop production.

The integration of fodder production into the farming system offers multiple benefits. It reduces dependency on expensive commercial feeds, improves the quality of animal products, enhances reproductive performance, and increases income for smallholder farmers. Moreover, fodder crops, especially legumes, contribute to soil fertility through nitrogen fixation, promote biodiversity, and help in climate change adaptation by providing a reliable feed source during droughts and off-seasons.

In countries like Nepal, where agriculture is largely subsistence-based and landholdings are small, adopting systematic fodder production practices is vital for improving the productivity of cattle, buffaloes, goats, and sheep. The promotion of community-based pasture development, fodder tree plantations, and home-based forage cultivation can play a significant role in transforming the livestock sector. With proper training, policy support, and access to quality seeds, fodder production can become a key driver of rural development and food security.

## 5.2 Terminology Related to Fodder Production

Some of the terminologies related to fodder production are:

**Fodder**

Cultivated plant material such as grasses and legumes that are harvested and fed to livestock.

**Forage**

Any edible plant material consumed by grazing animals, either directly (pasture)

or after harvesting (fodder).

**Pasture**

Land covered with grasses and legumes used for grazing livestock.

**Silage**

Fermented, high-moisture fodder stored anaerobically (without air) in pits, silos, or bags for use in dry seasons.

**Hay**

Dried forage (usually grass or legumes) stored for feeding animals during times when fresh fodder is unavailable.

**Cut-and-Carry System**

A feeding practice where fodder is cut from the field and transported to the livestock rather than allowing animals to graze.

**Grazing**

Allowing livestock to feed directly on natural or cultivated pastures.

**Green Fodder**

Fresh, succulent, high-moisture forage used directly as animal feed.

**Dry Fodder**

Low-moisture plant material (e.g., hay or crop residues like wheat straw) used as livestock feed.

**Crop Residues**

Leftover plant materials after harvesting crops, such as paddy straw, maize stalks, or wheat straw, used as feed.

**Leguminous Fodder**

Fodder from plants that belong to the legume family (e.g., berseem, lucerne, cowpea) that are rich in protein and fix atmospheric nitrogen.

**Grass Fodder**

Fodder obtained from grass species like Napier, Guinea grass, and Setaria, usually rich in fiber.

**Fodder Trees and Shrubs**

Tree species like Leucaena, Gliricidia, and Sesbania that provide nutritious leaves and twigs as feed.

**Rangeland**

Natural grassland ecosystems used for grazing domestic or wild animals.

**Overgrazing**

Grazing beyond the land's carrying capacity, leading to degradation of pasture and soil erosion.

**Defoliation**

Removal of leaves from fodder plants due to grazing or cutting, affecting regrowth.

**Multicut Fodder**

Fodder varieties (e.g., multicut Napier) that can be harvested multiple times a year.

**Annual Fodder Crops**

Crops that complete their life cycle in one growing season (e.g., maize, oat, sorghum).

**Perennial Fodder Crops**

Crops that live and produce fodder for more than two years (e.g., Napier grass, Guinea grass).

**Crude Protein (CP)**

The total protein content in fodder, an important indicator of nutritional quality.

**Dry Matter (DM)**

The portion of the fodder that remains after all water is removed, representing the actual nutrient content.

**Palatability**

The degree to which animals find a particular fodder acceptable and appetizing.

**Digestibility**

The proportion of fodder that can be broken down and absorbed by the animal's digestive system.

**Toxic Plants**

Certain plants or weeds that may be harmful or poisonous if consumed by livestock.

**Agroforestry**

Integration of trees and shrubs into agricultural systems, often including fodder trees to provide additional feed sources.

## 5.3 Importance and Scope of Fodder Production

Fodder production plays a pivotal role in improving livestock productivity, ensuring food security, and enhancing rural livelihoods. Livestock require a continuous supply of quality feed throughout the year to maintain their health, growth, reproduction, and production. Some of the importance and scope of fodder production are:

**Animal Nutrition:** Ensures adequate protein, fiber, and energy for livestock.

**Cost-effective Feeding:** Reduces reliance on expensive concentrate feeds.

**Productivity Enhancement:** Improves milk yield, weight gain, and reproductive efficiency.

**Environmental Benefits:** Prevents overgrazing, soil erosion, and degradation of rangelands.

**Year-Round Feed Supply:** Enables feed conservation through silage and haymaking.

**Supports Mixed Farming Systems:** Integrates well with crop farming for sustainable land use.

**Employment and Income Generation:** Provides opportunities for smallholder farmers through livestock-based enterprises.

## 5.4 Classification of Forage Crops

Forage crops can be classified based on various criteria such as life cycle, botanical type, season, and purpose. The main classifications are:

**A. Based on Life Cycle**

1. **Annual Forage Crops** : Complete their life cycle within one growing season (3–6 months). *Examples:* Maize, Sorghum, Oat, Cowpea.
2. **Biennial Forage Crops:** Require two growing seasons to complete their life cycle. *Examples:* Fodder beet, Ryegrass (in some climates).
3. **Perennial Forage Crops**: Live and provide fodder for more than two years. *Examples:* Napier grass, Guinea grass, Lucerne.

**B. Based on Botanical Type**

1. **Grasses (Poaceae family)**: Provide bulk roughage and are rich in fiber. *Examples:* Napier grass, Sudan grass, Setaria, Guinea grass.
2. **Legumes (Fabaceae family)**: Rich in protein and improve soil fertility through nitrogen fixation. *Examples:* Berseem, Lucerne, Cowpea, Stylo.

**C. Based on Growing Season**

1. **Monsoon Crops**: Grown during rainy season (June–September). *Examples:* Maize, Sorghum, Cowpea, Pearl millet.
2. **Winter Crops**: Grown during winter season (October–February). *Examples:* Oat, Berseem, Lucerne.

3. **Summer Crops:** Grown between rabi and kharif (March–May). *Examples:* Teosinte, Sudan grass.

**D. Based on Use or Purpose**

1. **Green Fodder Crops**: Used in fresh form for daily feeding. *Examples:* Maize, Berseem, Napier grass.
2. **Silage Crops**: Suitable for ensiling due to high sugar and moisture content. *Examples:* Maize, Sorghum.
3. **Hay Crops**: Dried and stored to feed animals in dry seasons. *Examples:* Lucerne, Oat, Berseem.
4. **Fodder Trees and Shrubs**: Provide leaves and branches as supplementary feed, especially during drought. *Examples:* Leucaena, Gliricidia, Sesbania.

## Exercise

**Choose the correct answer from the given alternatives.**

1. What does the term "forage" refer to?
   a. Only concentrates fed to animals
   b. Edible herbage eaten by animals
   c. Grains fed to poultry
   d. Only green leafy vegetables

2. Which of the following has the highest nutritional value among forages?
   a. Straw
   b. Berseem
   c. Wheat husk
   d. Rice bran

3. What percentage of Nepal's pasture area is used for animal feed?
   a. 50%
   b. 31.5%
   c. 17,57,345 ha
   d. 18.5%

4. What is dry matter in animal feed?
   a. Water content in feed
   b. Minerals in feed
   c. The part of feed that is not water
   d. The moisture level in roughage

5. What is the dry matter requirement for buffalo and crossbred cattle?
   a. 1.5–2 kg per 100 kg body weight
   b. 2–2.5 kg per 100 kg body weight
   c. 2.5–3 kg per 100 kg body weight
   d. 3.5–4 kg per 100 kg body weight

6. What nutrient is especially abundant in green fodder?
   a. Starch
   b. Carotene
   c. Salt
   d. Calcium

7. Which of the following is NOT an advantage of fodder trees?
   a. Used as wind-breakers
   b. Used for fencing
   c. Increases soil erosion
   d. Provides bedding material

8. Which fodder tree is propagated through vegetative parts and belongs to the Ficus genus?
   a. Gogan b. Kabro c. Kutmero d. Badahar

9. When is seed collection for Ipil-Ipil typically done?
   a. Ashar b. Chaitra c. Mangsir d. Baishakh

10. What distinguishes roughages from concentrates?
   a. Roughages are more expensive
   b. Roughages contain less than 10% fiber
   c. Roughages contain more than 18% crude fiber
   d. Roughages are mainly animal by-products

11. Which of the following is a legume green roughage?
   a. Sorghum b. Bajra
   c. Berseem d. Oat

12. Which is an example of a protein-rich concentrate from plant sources?
   a. Barley b. Mustard cake
   c. Sorghum d. Rice bran

13. Which of the following is NOT a drawback of fodder production in Nepal?
   a. Degraded rangelands
   b. Overpopulation of livestock
   c. Excess availability of concentrate feeds
   d. Poor participation of people

14. Which of the following is a carbonaceous feedstuff?

a. Soybean cake
b. Til cake
c. Crushed maize
d. Mustard cake

15. What is the largest source of animal feed in Nepal?

a. Pasture
b. Forest
c. Agricultural by-products
d. Imported feed

## Write short answer to the following questions.

1. What is forage in the context of animal feeding?
2. What is meant by dry matter in animal feed
3. What is the dry matter requirement for Zebu cattle?
4. Name two highly nutritious forage crops.
5. Why can't poultry be fed roughages?
6. What is the role of additives in animal feed?
7. Define forage. Write about the importance of forage crops.
8. Describe in detail about the classification of forage crops.
9. Write in detail about the various sources of concentrate feeds.

## Write long answer to the following questions.

1. Describe the nutritional importance and advantages of feeding green fodder to livestock. Include economic and health benefits.
2. List and explain at least five benefits of using fodder trees in animal husbandry.
3. Explain the classification of feedstuffs into roughages and concentrates. Give examples and explain their differences in nutrient composition.
4. Why are roughages called as bulky feeds?
5. What is the required ratio of roughages and concentrates for Ruminants, explain in detail.

# Unit 6

# Cultivation Practice/Propagation Nursery Management

## 6.1 Common Annual Cereal Fodder/Forage (Maize, Teosinte, Bajara, Oat,)

Annual cereal fodder crops are fast-growing grasses cultivated primarily for feeding livestock. These crops complete their life cycle within one growing season and are valued for their rapid biomass production, palatability, and nutritional content. They are particularly important during specific seasons (summer or winter) to meet green fodder shortages and improve livestock productivity. These crops provide energy-rich fodder and are easy to cultivate, making them ideal for smallholder and commercial farms.

### 6.1.1 Maize

Maize (Zea mays), commonly known as corn, is one of the most important cereal crops worldwide. It is widely cultivated for both human consumption and as a high-yielding fodder crop for livestock. Maize thrives in tropical and subtropical regions and provides abundant biomass suitable for green fodder, silage, and grain production. Its versatility and adaptability make it a key crop in mixed farming systems.

*Fig 2: Maize*

**Cultivation Practice of Maize**

- **Land Preparation:** Prepare a fine seedbed by ploughing and harrowing. Incorporate well-decomposed farmyard manure or compost.
- **Sowing Time:** Best sown in the Kharif season (June–July).
- **Seed Rate:** Use 30–40 kg/ha of quality seeds.
- **Spacing:** Maintain 60 cm between rows and 20 cm between plants.
- **Fertilizer:** Apply NPK at 100:50:25 kg/ha; split nitrogen application for better uptake.
- **Irrigation:** Provide 2–3 irrigations during critical stages like tasseling and silking.
- **Weed Control:** Manual weeding or herbicides at 20 and 40 days after sowing.
- **Harvesting:** Harvest for fodder at tasseling stage (~60–70 days) to maximize nutritional value.

**Propagation**

- Maize is propagated exclusively by **seeds**.
- Use certified seeds treated with fungicide to improve germination and reduce disease incidence.

**Nursery Management**

- Maize is generally **direct-sown** in the field.
- In some cases, seedlings can be raised in nursery beds or trays for 15–20 days.
- Seedlings should be kept moist and shaded until transplanting at the 3–4 leaf stage.

### 6.1.2 Teosinte

Teosinte (Euchlaena mexicana) is a wild grass native to Central America and considered the ancestor of modern maize. It is gaining attention as a valuable fodder crop due to its high biomass yield, rapid growth, and adaptability to different environmental conditions. Teosinte is commonly used for green fodder and silage, especially in regions where maize is also cultivated.

***Fig 3: Teosinte***

**Cultivation Practice of Teosinte**

- **Land Preparation:** Prepare a well-tilled seedbed by ploughing and harrowing. Incorporate organic manure such as farmyard manure for better soil fertility.

- **Sowing Time:** Best sown at the onset of monsoon (June–July) for optimal growth.
- **Seed Rate:** Approximately 25–30 kg per hectare.
- **Spacing:** Recommended spacing is 30 cm between rows and 15 cm between plants within the row to allow good aeration and nutrient access.
- **Fertilizer:** Apply balanced NPK fertilizer (80:40:20 kg/ha), with nitrogen applied in splits.
- **Irrigation:** Requires irrigation during dry periods, especially during initial growth and before flowering.
- **Weed Control:** Manual weeding or use of herbicides at 20 and 40 days after sowing.
- **Harvesting:** First cut is generally done 60 days after sowing, with subsequent cuts at 30-day intervals due to its rapid regrowth.

**Propagation**

- Propagated by **seeds**.
- Use healthy, high-quality seeds to ensure uniform germination and vigorous growth.

**Nursery Management**

- Typically, teosinte is **direct-sown** in the field.
- In some cases, seedlings may be raised in nursery beds for 3–4 weeks and then transplanted.
- Seedlings require adequate moisture and protection from pests until well-established.

### 6.1.3 Bajara

Bajra, scientifically known as *Pennisetum glaucum*, is a hardy and drought-tolerant cereal crop widely grown in arid and semi-arid regions. It is valued both as a food grain and as a nutritious fodder crop. Bajra grows well in poor soils

and requires minimal water, making it an important crop for fodder production in dry areas.

*Fig 4: Bajara*

**Cultivation Practice of Bajra**

- **Land Preparation:** Prepare a well-tilled seedbed by ploughing and leveling the field. Incorporate organic matter such as farmyard manure to improve soil fertility.
- **Sowing Time:** Sown primarily during the Kharif season (June–July).
- **Seed Rate:** Use about 10–15 kg of seeds per hectare.
- **Spacing:** Maintain 45 cm between rows and 10 cm between plants.
- **Fertilizer:** Apply NPK fertilizer at 60:40:20 kg/ha; nitrogen may be split-applied for better uptake.
- **Irrigation:** Bajra is drought-tolerant but benefits from irrigation during critical growth stages like flowering and grain filling.
- **Weed Control:** Carry out manual weeding twice during early growth or use selective herbicides.
- **Harvesting:** Harvest green fodder at 50% flowering (approximately 45–60 days after sowing) for optimal nutritive value.

**Propagation**

- Bajra is propagated by **seeds**.
- Use quality seeds, preferably treated with fungicide, to ensure good germination and early vigor.

**Nursery Management**

- Bajra is generally **direct-sown**; nursery raising is uncommon.
- In some cases, seedlings can be raised in nursery beds for 15–20 days before transplanting, especially in areas with shorter growing seasons.
- Seedlings require adequate moisture and protection until establishment.

### 6.1.4 Oat

Oat (*Avena sativa*) is a cool-season cereal crop widely grown for both grain and high-quality fodder. It thrives in temperate and subtropical regions with moderate rainfall and cool temperatures. Oat fodder is palatable and nutritious, making it a valuable feed resource for livestock during the winter season.

***Fig 5: Oat***

**Cultivation Practice of Oat**

- **Land Preparation:** Prepare a fine seedbed by ploughing and harrowing. Incorporate organic manure such as farmyard manure or compost to improve soil fertility.

- **Sowing Time:** Best sown in the Rabi season (October–November) when temperatures are cooler.
- **Seed Rate:** Use 80–100 kg of seeds per hectare for fodder purposes.
- **Spacing:** Sow in rows with spacing of 25 cm between rows and 10 cm between plants.
- **Fertilizer:** Apply balanced NPK fertilizers (100:60:40 kg/ha), with nitrogen applied in split doses to promote healthy growth.
- **Irrigation:** Requires 4–5 irrigations, especially during dry spells, to ensure optimal growth.
- **Weed Control:** Manual weeding or selective herbicides at 20 and 40 days after sowing.
- **Harvesting:** First cut is usually taken at 60 days after sowing, with subsequent cuts every 30 days for sustained fodder production.

**Propagation**

- Oat is propagated by **seeds**.
- Use high-quality seeds treated with fungicides to reduce seed-borne diseases and improve germination.

**Nursery Management**

- Oat is usually **direct-sown** in the field.
- In some cases, seedlings may be raised in nursery beds for 20–25 days and then transplanted to ensure a longer growing period in cooler regions.
- Seedlings require adequate moisture and protection from pests and diseases.

## 6.2 Common Perennial Fodder/Forages (Napier, Para, Guinea, Seteria, Molasses, Paspalum)

Perennial fodder crops are forage species that live and produce biomass for more than two years after planting. Unlike annuals, they do not need to be sown every season, making them more economical and sustainable for long-term fodder production. These forages are highly productive, tolerant to periodic stress

(drought or heavy rain), and well-suited for cut-and-carry systems or grazing. Perennial forages improve soil fertility, reduce erosion, and ensure a consistent supply of nutritious green fodder throughout the year, especially during lean seasons.

### 6.2.1 Napier

Napier grass (Pennisetum purpureum), commonly known as elephant grass, is a fast-growing, high-yielding **perennial tropical fodder grass** widely used in dairy and livestock farming systems. It is popular for its **excellent re-growth capacity**, **good palatability**, and adaptability to various agro-climatic conditions. Due to its **high biomass output and nutritional quality**, Napier is ideal for cut-and-carry systems and is essential for sustainable year-round fodder supply.

***Fig 6: Napier***

**Cultivation Practices**

- **Climate:** Grows best in tropical and subtropical climates with moderate to high rainfall (1000–2500 mm/year). It thrives in warm temperatures (25–35°C).
- **Soil:** Prefers fertile, well-drained loamy soils rich in organic matter. Avoid waterlogged or highly acidic soils.
- **Land Preparation:** Plow the land thoroughly to obtain a fine tilth. Incorporate

15–20 tons of well-decomposed FYM (farmyard manure) per hectare into the soil before planting.

- **Spacing:** Plant slips or stem cuttings in rows spaced **75 cm apart**, with **50 cm between plants** within rows.

**Propagation**

- Napier grass is **vegetatively propagated**, as seeds are mostly sterile or have poor viability.

**Propagation Materials**

- **Stem cuttings:** Use cuttings 30–45 cm long with 2–3 nodes.
- **Root slips:** Healthy, disease-free tillers with roots attached.
- **Planting time:**Best planted at the onset of the monsoon (June–July) or in spring with irrigation.
- **Planting method**
    - Insert cuttings/slips into moist soil at an angle or vertically.
    - Ensure at least one node is below the soil surface.
    - Press soil firmly around the base for good root contact.

**Nursery Management**

- Prepare a small, well-irrigated nursery area to raise planting materials.
- Use fertile soil and apply FYM or compost.
- Plant slips or cuttings in close rows and irrigate regularly.
- After 45–60 days, when rooted and tillering, transplant to the main field.
- Protect nursery from weeds, pests, and grazing.

**Irrigation & Management**

- **Irrigation:** Provide water at 7–10 day intervals during dry periods. Irrigate immediately after planting and after each harvest.
- **Fertilization**

- Apply 60:40:20 kg/ha NPK at planting.
- After each cut, top-dress with 40–60 kg N/ha for better regrowth.

- **Weed Control:** Weed regularly during early growth stages. After canopy closes, weed competition reduces.

**Harvesting**

- First cut at 60–75 days after planting.
- Subsequent cuts every 30–45 days.
- Maintain a stubble height of 5–10 cm to ensure good regrowth.

### 6.2.2 Para Grass

Para grass (Brachiaria mutica) is a vigorous, **spreading perennial grass** widely cultivated in tropical and subtropical regions as a high-yielding **fodder for cattle and buffaloes**. It is also known for its ability to thrive in **wet, marshy, and low-lying areas**, making it especially valuable in regions with waterlogging or high water tables. Its **palatability, high biomass yield, and rapid regrowth** make it a dependable green fodder source, especially in humid zones.


***Fig 7: Para grass***

**Cultivation Practices**

- **Climate:** Prefers **hot, humid climates** and performs well in **rainfall zones over 1000 mm/year**. It is highly suited for tropical lowlands.
- **Soil:** Best suited to **moist, fertile clayey or loamy soils**. Tolerates temporary waterlogging but is less suited to drought-prone areas.
- **Land Preparation**
    - Plough and level the field thoroughly.
    - Mix in **10–15 tons of FYM** (farmyard manure) per hectare.
    - Ensure the field is well-leveled to retain moisture uniformly.
    - **Spacing:** Plant stem cuttings at **60 cm x 60 cm** spacing for optimum tillering and canopy cover.

**Propagation**

- **Method:** Para grass is **propagated vegetatively** as it sets few viable seeds.
- **Planting Material:** Use **healthy stem cuttings** 30–45 cm long with at least **3 nodes**.
- **Planting Season:** Best planted during **early monsoon (June–July)** or in spring with irrigation facilities.
- **Planting Technique**
    - Insert stem cuttings **obliquely or horizontally** into moist soil.
    - Ensure one or two nodes are buried and one remains above the ground.
    - Compact the soil around the cutting to improve rooting.

**Nursery Management**

- **Nursery Bed Preparation:** Choose a **moist, shaded area**. Apply compost and prepare the bed with fine tilth.
- **Cutting Management**
    - Plant stem cuttings in rows close together.
    - Maintain adequate soil moisture through regular irrigation.

**Care**

- Weed regularly.
- Protect from grazing or trampling.
- Cut and transplant when rooted and well-tillered (about **30–45 days** after planting).

**Irrigation & Management**

- **Irrigation**
  - Water every **7–10 days** in dry conditions.
  - Suited to areas with standing water or irrigated paddy fields.
- **Fertilization**
  - Apply **40:30:20 kg NPK/ha** as a basal dose.
  - Top-dress with **40–50 kg N/ha** after each harvest for vigorous regrowth.
- **Weed Control**
  - Regular weeding is important in the initial stages.
  - Dense canopy eventually suppresses weeds naturally.

**Harvesting**

- First cut after **60–75 days** of planting.
- Subsequent cuts at **30–45-day** intervals.
- Leave a stubble height of **5–10 cm** to encourage fast regrowth.

### 6.2.3 Guinea Grass

Guinea grass is a **robust, tufted perennial grass** widely grown in tropical and subtropical regions as a **high-yielding, nutritious forage crop**. Known for its excellent **palatability**, **rapid regrowth**, and adaptability to a variety of environments, Guinea grass is a popular choice for **cut-and-carry feeding systems** and can be conserved as **hay or silage**. It supports multiple harvests annually and is especially valuable for **dairy and beef cattle**.

*Fig 8: Guinea Grass*

**Cultivation Practices**

- **Climate:** Thrives in **warm, tropical climates** with annual rainfall of **1000–1500 mm**. It can tolerate short dry periods but grows best under moderate moisture.
- **Soil:** Grows well in a range of soils from **loamy to clay loam**, preferring **well-drained, fertile soils** with **pH 5.5–7.0**.
- **Land Preparation:**
    - Deep ploughing followed by harrowing to achieve fine tilth.
    - Incorporate **10–15 tons/ha FYM** or compost before planting.
    - **Spacing:** Plant slips or rooted tillers at a spacing of **60 cm x 60 cm**.

**Propagation**

- **Method:** Propagated **vegetatively** through **rooted slips or stem cuttings**, although **seeds** can also be used but have low viability.
- **Planting Material:** Use **vigorous, disease-free slips or rooted tillers** about 20–30 cm in length.

- **Planting Time:** Best planted at the onset of the **monsoon (June–July)** or with irrigation during spring.

**Planting Technique**

- Dig small pits or furrows and insert slips firmly.
- Water immediately after planting.

**Nursery Management**

- **Nursery Bed:** Prepare a **well-drained, fertile nursery** plot with adequate moisture and partial shade.
- **Slip Development**
  - Plant tillers in rows.
  - Apply FYM and maintain good moisture.
  - After 30–45 days, slips with well-formed roots are ready for transplanting.
- **Care:**
  - Keep nursery weed-free.
  - Protect from grazing and pests.

## Irrigation & Management

**Irrigation**

- Requires regular watering, especially during dry periods (every **7–10 days**).
- Avoid waterlogging.

**Fertilization**

- Apply **40:30:20 kg NPK/ha** as a basal dose.
- Top-dress with **30–40 kg N/ha** after each cut to encourage regrowth.

**Weed Control**

- Crucial during the first month.
- Dense canopy later suppresses most weeds.

**Harvesting**

- **First Cut:** After **60–75 days** of planting or when plants reach **1–1.2 meters** in height.
- **Subsequent Cuts:** At **30–45-day intervals**, depending on growth and season.
- **Stubble Height:** Leave about **10 cm** stubble for fast regrowth.

### 6.2.4 Seteria

Setaria grass is a fast-growing, perennial tropical grass widely used as fodder for livestock due to its high palatability and good nutritional value. It thrives in warm climates with moderate rainfall and is well adapted to a variety of soil types, making it popular in many tropical and subtropical regions. Setaria is commonly grown for grazing, hay, and silage and is especially valued for its ability to produce good biomass even under less fertile soil conditions.

Setaria species like Setaria sphacelata and Setaria anceps are among the most commonly cultivated varieties for fodder production. They have a deep root system, which helps in soil conservation and drought tolerance.

***Fig9: Setaria grass***

**Cultivation Practices**

- **Climate and Soil:** Setaria grass prefers warm climates with temperatures ranging from 25 to 35°C. It grows well in areas with annual rainfall between

800 mm and 1500 mm. The grass tolerates a wide range of soils, from sandy loam to clay, but performs best in well-drained, fertile soils with a pH range of 5.5 to 7.5.

- **Land Preparation:** The land should be thoroughly plowed and harrowed to create a fine seedbed. Remove all weeds and ensure good soil tilth for better seed-soil contact.
- **Sowing Time:** The best time for sowing Setaria is at the onset of the rainy season to ensure adequate moisture for seed germination and early growth.
- **Seed Rate:** For pure stands, use approximately 4 to 6 kg of seed per hectare. If mixed with legumes, adjust the seed rate accordingly.
- **Sowing Method:** Seeds can be broadcasted followed by light harrowing or drilled in rows spaced about 30 to 45 cm apart for better growth and management.
- **Fertilizer Application:** Apply nitrogen, phosphorus, and potassium fertilizers based on soil test recommendations. A typical dose might be 60-80 kg N, 30-40 kg $P_2O_5$, and 20-30 kg $K_2O$ per hectare.
- **Weed Control:** Manage weeds during early growth stages manually or with suitable herbicides to reduce competition.

**Propagation**

- **By Seed:** Setaria is mainly propagated through seeds. Seeds are small and require careful handling. Scarification or soaking seeds overnight in water may improve germination rates.
- **By Suckers or Division:** In some cases, propagation can be done through tillers or division of clumps, especially for establishing new fields quickly.

**Nursery Management**

- **Nursery Preparation:** Prepare a nursery bed with well-tilled soil and ensure good drainage. The bed should be free from weeds.
- **Seed Treatment:** Treat seeds with fungicides or soak them in water for 12-

24 hours before sowing to enhance germination.

- **Sowing:** Sow seeds thinly in rows or broadcast in nursery beds. Maintain moisture by regular watering.
- **Seedling Care:** Thin the seedlings if too crowded to ensure proper growth. Protect seedlings from pests and diseases.
- **Transplanting:** Seedlings can be transplanted after 3-4 weeks to the main field if required, though direct sowing is more common.

### 6.2.5 Mollases

Molasses (Melinis minutiflora) is a perennial tropical forage grass valued for its high biomass production and palatability to livestock. It is widely grown in tropical and subtropical regions as a pasture grass due to its adaptability to a variety of soil types and climatic conditions. The grass is named for its sweet-smelling, molasses-like aroma, which makes it attractive to grazing animals.

Molasses is commonly used for grazing, hay, and green fodder, and it plays an important role in soil conservation because of its dense root system that reduces erosion. It thrives in acidic to neutral soils and can tolerate moderate drought once established.

***Fig 10: Molasses***

**Cultivation Practices**

- Climate and Soil: Molasses grass grows best in warm tropical climates with annual rainfall between 800 mm and 2000 mm. It tolerates a wide range of soils but prefers well-drained, loamy to sandy soils with a pH of 5.5 to 6.5. It can adapt to poorer soils where other grasses might struggle.
- Land Preparation: Prepare the land by plowing and harrowing to create a fine seedbed. Remove weeds and ensure the field is level to promote uniform germination.
- Sowing Time: The ideal time for sowing is at the beginning of the rainy season to ensure adequate moisture for seed germination and seedling establishment.
- Seed Rate: Use approximately 4 to 6 kg of seed per hectare for pure stands. If mixed with legumes or other grasses, adjust seed rates accordingly.
- Sowing Method: Seeds can be broadcasted evenly followed by light harrowing or drilled in rows spaced 30 to 45 cm apart for better management.
- Fertilizer Application: Apply basal fertilizers according to soil tests. A typical recommendation is 40-60 kg N, 20-30 kg $P_2O_5$, and 10-20 kg $K_2O$ per hectare annually. Split nitrogen applications can improve growth.
- Weed Control: Control weeds mechanically or chemically before sowing and during early growth to reduce competition.

**Propagation**

- By Seed: Molasses grass is primarily propagated by seed. Seeds are small and should be sown promptly after harvest to maintain viability. Seed treatment (such as soaking or scarification) may improve germination.
- By Division: Propagation can also be done by dividing mature clumps, though this is less common than seed propagation.

**Nursery Management**

- Nursery Preparation: Prepare a well-tilled, weed-free nursery bed with good drainage. Incorporate organic matter to improve soil fertility.

- Seed Treatment: Soak seeds in water for 12-24 hours or treat with fungicides to reduce seed-borne diseases and enhance germination.
- Sowing: Sow seeds thinly and evenly in nursery beds, either broadcast or in rows. Keep soil moist but not waterlogged.
- Seedling Care: Thin seedlings if overcrowded to ensure vigorous growth. Protect young plants from pests and diseases.
- Transplanting: Seedlings may be transplanted after 3-4 weeks to prepared fields if necessary, but direct seeding is the usual practice.

### 6.2.6 Paspalum

Paspalum is a group of perennial tropical and subtropical grasses widely grown as forage for livestock. Species like Paspalum notatum (Bahiagrass) and Paspalum dilatatum (Dallisgrass) are popular for their high productivity, palatability, and ability to thrive in a variety of soil and climatic conditions. Paspalum grasses are well adapted to warm climates and can tolerate periodic flooding, drought, and acidic soils, making them suitable for diverse environments.

They are mainly used for grazing, hay, and silage, providing good-quality green fodder throughout much of the year. Paspalum also helps improve soil structure and reduce erosion due to its dense root system.

***Fig 11: Paspalum grass***

**Cultivation Practices**

- Climate and Soil: Paspalum grows best in tropical to subtropical regions with temperatures ranging from 20 to 35°C. It requires moderate rainfall between 800 mm and 1500 mm annually. It adapts well to a wide range of soils, including sandy, loamy, and heavy clay soils, and tolerates slightly acidic to neutral pH (5.5 to 7.0).
- Land Preparation: Thoroughly plow and harrow the field to create a fine, firm seedbed. Remove all weeds and debris to reduce competition.
- Sowing Time: The ideal time for sowing is at the start of the rainy season, which ensures adequate moisture for seed germination and seedling growth.
- Seed Rate: The recommended seed rate for pure stands is about 5 to 7 kg per hectare. When mixed with legumes or other grasses, adjust accordingly.
- Sowing Method: Seeds can be broadcast followed by light harrowing or drilled in rows spaced 30 to 45 cm apart to facilitate weeding and management.
- Fertilizer Application: Apply fertilizer based on soil testing, typically 50-70 kg nitrogen, 20-40 kg phosphorus ($P_2O_5$), and 20-30 kg potassium ($K_2O$) per hectare annually. Split nitrogen applications can enhance growth.
- Weed Control: Control weeds before sowing and during the early growth stage by manual or chemical means to ensure good establishment.

**Propagation**

- By Seed: Paspalum is commonly propagated by seed. Seeds should be fresh and viable, and pre-sowing treatment like soaking for 12-24 hours may improve germination rates.
- By Vegetative Means: Some species can be propagated by stolons or rhizomes, which helps establish pasture more quickly and is often used in sod production.

**Nursery Management**

- Nursery Preparation: Prepare a well-tilled, weed-free nursery bed with good

drainage and fertility. Incorporate organic matter if possible.

- Seed Treatment: Seeds can be soaked overnight in water or treated with fungicides to improve germination and reduce seed-borne diseases.
- Sowing: Sow seeds thinly and uniformly either by broadcasting or in rows. Keep soil moist until seedlings are well established.
- Seedling Care: Thin overcrowded seedlings to prevent competition and allow healthy growth. Protect seedlings from pests and diseases.
- Transplanting: Seedlings can be transplanted after 3-4 weeks if nursery raising is practiced, though direct sowing is generally preferred.

## 6.3 Common Annual Legumes (Cowpea, Pea, Joint Vetch, Berseem)

Annual legumes are plants that complete their life cycle within one growing season. They are important in agriculture for their ability to fix atmospheric nitrogen, improve soil fertility, and provide nutritious forage or grain for livestock. These legumes are often grown as green manure, cover crops, or fodder.

### 6.3.1 Cowpea

Cowpea (Vigna unguiculata) is a warm-season annual legume widely cultivated as a fodder and pulse crop. It is drought-tolerant and thrives well in tropical and subtropical regions. Cowpea is valued for its high protein content and nitrogen-fixing ability, making it an excellent forage crop for livestock and a soil improver.

***Fig 12: Cow pea***

**Cultivation Practices**

- **Climate and Soil:** Prefers warm temperatures (25-35°C) and well-drained sandy loam to loamy soils with pH 5.5–7.0.
- **Land Preparation:** Well-plowed and harrowed seedbed free from weeds.
- **Sowing Time:** Late spring to early summer, coinciding with warm weather and adequate soil moisture.
- **Seed Rate:** 20-30 kg/ha.
- **Sowing Method:** Seeds are drilled or broadcast in rows spaced 30-40 cm apart.
- **Fertilizer:** Low nitrogen needed due to nitrogen fixation; phosphorus (20-40 kg $P_2O_5$/ha) and potassium (20-30 kg $K_2O$/ha) recommended.
- **Weed Control:** Mechanical or chemical weed control before and after sowing.

**Propagation**

- Propagated by seed, preferably treated with Rhizobium inoculant for nitrogen fixation.

**Nursery Management**

- Seeds soaked 6-12 hours before sowing.
- Sown thinly in nursery beds with moist, fertile, well-drained soil.
- Thin seedlings if crowded; protect from pests and diseases

### 6.3.2 Pea

Pea (Pisum sativum) is a cool-season annual legume cultivated as forage and grain. It prefers temperate climates and is valued for its high protein content and palatability. Pea also fixes atmospheric nitrogen, improving soil fertility.

***Fig13: Pea***

**Cultivation Practices**

- **Climate and Soil:** Grows best at 13-18°C in well-drained loamy soils with pH 6.0-7.5.
- **Land Preparation:** Fine seedbed preparation with plowing and harrowing.
- **Sowing Time:** Late winter to early spring.
- **Seed Rate:** 70-100 kg/ha.
- **Sowing Method:** Seeds drilled or broadcast in rows 20-30 cm apart.
- **Fertilizer:** Low nitrogen; phosphorus and potassium as per soil test.
- **Weed Control:** Pre- and post-emergence weed management.

**Propagation**

- Propagated by seed; Rhizobium inoculation recommended for better nitrogen fixation.

**Nursery Management**

- Seeds soaked briefly to improve germination.
- Sown thinly in well-prepared nursery beds.
- Protect seedlings from pests and fungal infections.

### 6.3.3 Joint vetch

Joint Vetch (Aeschynomene spp.) is an annual legume suited to tropical and subtropical regions, commonly used as green fodder and green manure. It grows well in wet and flooded conditions and fixes nitrogen, enhancing soil fertility.

***Fig 14: Joint vetch***

**Cultivation Practices**

- **Climate and Soil:** Prefers warm, moist conditions with rainfall above 800 mm; grows well in loamy and clay soils, tolerating waterlogging.
- **Land Preparation:** Well-tilled and level seedbed.
- **Sowing Time:** Early summer or rainy season.
- **Seed Rate:** 15-25 kg/ha.
- **Sowing Method:** Broadcast or drilled in rows 30 cm apart.
- **Fertilizer:** Minimal nitrogen needed; phosphorus and potassium applied as per recommendations.
- **Weed Control:** Manage early weeds mechanically.

**Propagation**

- Propagated by seed; seed treatment and Rhizobium inoculation advised.

**Nursery Management**

- Seeds soaked 12-24 hours before sowing.
- Sow thinly in moist nursery beds.
- Protect seedlings from pests and waterlogging.

### 6.3.4 Berseem

Berseem (Trifolium alexandrinum), or Egyptian clover, is a cool-season annual legume extensively grown as high-quality green fodder in irrigated areas. It grows rapidly and provides multiple cuttings during the season. It is rich in protein and improves soil fertility by nitrogen fixation.

***Fig 15: Berseem***

**Cultivation Practices**

- **Climate and Soil:** Grows best in temperate climates (15-25°C) with irrigation; prefers well-drained loamy soils with pH 6.5-7.5.
- **Land Preparation:** Fine seedbed preparation to ensure good seed-soil contact.
- **Sowing Time:** Late winter to early spring.

- **Seed Rate:** 15-20 kg/ha.
- **Sowing Method:** Broadcast or drilled in rows 20-30 cm apart.
- **Fertilizer:** Phosphorus and potassium as per soil test; little nitrogen needed.
- **Weed Control:** Early weed control essential.

**Propagation**

- Propagated by seed, preferably inoculated with Berseem-specific Rhizobium.

**Nursery Management**

- Seeds soaked briefly before sowing.
- Sown thinly in nursery beds with regular irrigation.
- Thin seedlings if necessary and protect from pests and diseases.

## 6.4 Common Perennial Legumes (Stylosanthes, Lucerne, Forage Peanut)

Common perennial legumes are plants that live and produce forage for more than two years. They play a crucial role in sustainable agriculture by providing high-protein fodder for livestock, improving soil fertility through nitrogen fixation, and enhancing soil structure. These legumes are well adapted to a variety of climates and soils, especially in tropical and subtropical regions, and are often used in pastures, mixed cropping systems, and soil conservation programs.

Popular perennial legumes such as **Stylosanthes**, **Lucerne (Alfalfa)**, and **Forage Peanut** contribute significantly to livestock nutrition and land productivity due to their persistence, high biomass yield, and ability to enrich the soil with nitrogen.

### 6.4.1 Stylosanthes

Stylosanthes, commonly known as stylo, is a group of tropical and subtropical perennial legumes widely used as forage due to its high adaptability to poor soils, drought tolerance, and nitrogen-fixing ability. It is highly palatable and nutritious for livestock and helps improve soil fertility. Stylosanthes is often used in mixed pastures and agroforestry systems.

*Fig 16: Stylo*

**Cultivation Practices**

- **Climate and Soil:** Thrives in warm climates with annual rainfall of 800–1500 mm. Prefers well-drained soils ranging from sandy loam to clay but tolerates acidic and low-fertility soils.
- **Land Preparation:** Prepare a clean, weed-free seedbed by plowing and harrowing.
- **Sowing Time:** Early rainy season to ensure adequate moisture for establishment.
- **Seed Rate:** 5-10 kg/ha depending on species and sowing method.
- **Sowing Method:** Seeds can be broadcast or drilled in rows spaced 30-45 cm apart.
- **Fertilizer:** Phosphorus and potassium may be applied based on soil tests; low nitrogen requirements due to nitrogen fixation.
- **Weed Control:** Control weeds mechanically or chemically during early growth stages.

**Propagation**

- Propagated by seed; scarification or soaking seeds overnight improves germination.

**Nursery Management**

- Seeds treated by soaking or scarification.
- Sown thinly in nursery beds with well-drained fertile soil.
- Maintain moisture and thin seedlings as needed to prevent overcrowding.

### 6.4.2 Lucerne

Lucerne (Medicago sativa) also known as alfalfa, is a high-quality perennial legume forage crop widely cultivated in temperate and subtropical regions. It is valued for its high protein content, digestibility, and deep rooting system that allows drought resistance and soil improvement. Lucerne is used for grazing, hay, and silage.

***Fig 17: Lucerne***

**Cultivation Practices**

- **Climate and Soil:** Prefers temperate climates with moderate rainfall (400–800 mm) and well-drained loamy soils with neutral to slightly alkaline pH (6.5-7.5).

- **Land Preparation:** Thoroughly plow and harrow to prepare a fine seedbed, free from weeds and clods.
- **Sowing Time:** Early spring or late winter in temperate zones.
- **Seed Rate:** 15-20 kg/ha.
- **Sowing Method:** Drill seeds in rows spaced 15-30 cm apart for good establishment.
- **Fertilizer:** Requires phosphorus and potassium; nitrogen usually not needed due to nitrogen fixation.
- **Weed Control:** Early weed control is critical to reduce competition.

**Propagation**

- Propagated by seed; seed treatment with Rhizobium inoculants enhances nitrogen fixation and establishment.

**Nursery Management**

- Seeds may be scarified or treated before sowing.
- Sow in well-prepared nursery beds with regular irrigation.
- Thin seedlings if overcrowded and protect from pests and diseases.

### 6.4.3 Forage Peanut

Forage peanut (Arachis pintoi) is a perennial legume native to South America, valued for its high protein content and excellent ground cover. It is used as a forage crop in tropical and subtropical regions and is especially useful in mixed pastures and erosion control. Forage peanut fixes nitrogen and improves soil health.

*Fig 18: Peanut*

**Cultivation Practices**

- **Climate and Soil:** Thrives in tropical and subtropical climates with rainfall of 800–1500 mm. Prefers well-drained sandy to loamy soils, tolerates acidic conditions.
- **Land Preparation:** Prepare well-tilled, weed-free seedbeds.
- **Sowing Time:** Early rainy season to promote establishment.
- **Seed Rate:** Generally propagated vegetatively (runners or stolons); seed use is less common.
- **Sowing Method:** Vegetative propagation by planting stolons or runners spaced about 30-40 cm apart.
- **Fertilizer:** Apply phosphorus and potassium based on soil tests; nitrogen not usually required.

- **Weed Control:** Maintain weed-free conditions during early establishment.

**Propagation**

- Mainly propagated vegetatively by stolons or runners; seeds are rarely used due to low viability.

**Nursery Management**

- Prepare nursery beds with fertile, well-drained soil.
- Plant stolons/runners and keep moist until establishment.
- Manage pests and diseases; thin stands if needed.

## 6.5 Common fodder trees (IpilIpil, Tanki, Badahar, Kimbu, Kabhro,kutmiro, koilaro)

Fodder trees are woody plants that provide nutritious leaves and twigs for livestock feed, especially during dry seasons when grass is scarce. They are rich in protein, minerals, and vitamins, making them excellent supplements to improve animal health and productivity. Fodder trees also help in soil conservation, reduce erosion, and enhance farm biodiversity.

### 6.5.1 IpilIpil

pil-ipil (Leucaena leucocephala) is a fast-growing, multipurpose leguminous tree widely used as fodder for ruminants. It is valued for its high protein-rich leaves and pods, which are highly palatable and digestible. Ipil-ipil also fixes atmospheric nitrogen, improving soil fertility, and is used in agroforestry systems and soil erosion control.

*Fig 19: Ipilipil*

**Cultivation Practices**

- **Climate and Soil:** Thrives in tropical and subtropical climates with annual rainfall of 700–1500 mm. Adapted to a wide range of soils but prefers well-drained loamy to sandy soils with pH 6.0–8.0.
- **Land Preparation:** Land should be cleared and plowed. Seedbeds or pits are prepared for planting.
- **Planting Time:** Best planted at the start of the rainy season.
- **Spacing:** Typically planted at 2-3 m spacing in rows.
- **Fertilizer:** Usually not required due to nitrogen fixation; phosphorus and potassium may be applied in poor soils.
- **Weed Control:** Keep area weed-free during early establishment.

**Propagation**

- Propagated primarily by seed; scarification or soaking seeds overnight improves germination.

- Also propagated by stem cuttings or root suckers.

**Nursery Management**

- Seeds soaked or scarified before sowing.
- Sown in nursery beds or polythene bags filled with fertile soil and compost.
- Maintain moisture and protect seedlings from pests.

### 6.5.2 Tanki

Tanki (Albizia lebbeck) is a medium-sized leguminous tree used for fodder, shade, and timber. Its leaves and pods are nutritious and palatable to livestock. The tree improves soil fertility through nitrogen fixation and adapts well to tropical and subtropical climates.

***Fig 20: Tanki***

**Cultivation Practices**

- **Climate and Soil:** Prefers tropical and subtropical climates with annual rainfall 750–1500 mm. Adapted to a variety of soils including lateritic and sandy soils.
- **Land Preparation:** Clear land, plow and prepare planting holes or beds.
- **Planting Time:** Early rainy season is ideal for planting.
- **Spacing:** 3-5 m spacing recommended for optimum growth.

- **Fertilizer:** Phosphorus and potassium as needed.
- **Weed Control:** Maintain weed-free zone during early growth.

**Propagation**

- Propagated by seeds, which should be scarified for better germination.
- Seedlings may also be raised from cuttings in some cases.

**Nursery Management**

- Seeds soaked or mechanically scarified before sowing.
- Sown in nursery beds or containers with fertile, well-drained soil.
- Regular watering and shading during hot weather help seedling survival.

### 6.5.3 Badahar

Badahar refers to various species of fig trees whose leaves and tender branches are used as fodder. These trees are drought-tolerant and provide an important source of roughage and minerals during dry seasons.

***Fig 21: Badahar***

**Cultivation Practices**

- **Climate and Soil:** Adapted to tropical and subtropical climates with rainfall 600–1500 mm. Tolerates a wide range of soils including rocky and poor soils.
- **Land Preparation:** Minimal land preparation needed as fig trees are hardy; planting pits should be dug.
- **Planting Time:** Beginning of rainy season preferred.
- **Spacing:** 5-8 m spacing for larger growth.
- **Fertilizer:** Organic manures improve growth; chemical fertilizers rarely necessary.
- **Weed Control:** Keep area clean especially around young plants.

**Propagation**

- Commonly propagated by seeds, cuttings, or air layering.
- Seed germination can be slow; cuttings and layering ensure faster establishment.

**Nursery Management**

- Cuttings or air layers planted in nursery beds with good drainage.
- Water regularly to maintain moisture.
- Protect from pests and diseases.

### 6.5.4 Kimbu

Kimbu is a fast-growing leguminous tree with nutritious foliage used as livestock fodder. It is drought tolerant and contributes to soil fertility through nitrogen fixation.

**Cultivation Practices**

- **Climate and Soil:** Thrives in tropical/subtropical areas with annual rainfall 800–1400 mm. Prefers well-drained soils but tolerates a range of conditions.
- **Land Preparation:** Clear and prepare soil for planting.
- **Planting Time:** Early rainy season best.

- **Spacing:** 3-4 m spacing recommended.
- **Fertilizer:** Low fertilizer requirements; phosphorus beneficial in poor soils.
- **Weed Control:** Maintain weed-free conditions especially during early growth.

**Propagation**

- Propagated by seed; seeds require scarification or soaking.
- Can also be propagated by stem cuttings.

**Nursery Management**

- Seeds soaked or mechanically scarified before sowing.
- Raised in nursery beds or bags with fertile soil.
- Water regularly and protect seedlings from pests.

### 6.5.5 Kabhro

Kabhro is a fig species whose leaves and fruits are used as fodder. It is well adapted to subtropical environments and is valued for fodder during dry periods.

**Cultivation Practices**

- **Climate and Soil:** Prefers subtropical climates with moderate rainfall. Grows in a variety of soils including rocky substrates.
- **Land Preparation:** Minimal preparation; planting pits recommended.
- **Planting Time:** Early rainy season.
- **Spacing:** 5-7 m spacing to accommodate tree growth.
- **Fertilizer:** Organic manure application benefits growth.
- **Weed Control:** Maintain weed-free conditions around young trees.

**Propagation**

- Propagated by seeds, cuttings, or air layering.
- Vegetative propagation favored for quicker growth.

**Nursery Management**

- Use cuttings or air layers in nursery beds.
- Regular watering and shading necessary.
- Protect from pests and fungal infections.

### 6.5.6 Kutmiro

Kutmiro, or white mulberry, is a deciduous tree with highly nutritious leaves used for livestock fodder and silkworm cultivation. It grows fast and is tolerant of a wide range of soils and climates.

**Cultivation Practices**

- **Climate and Soil:** Prefers temperate to subtropical climates with moderate rainfall. Grows well in well-drained loamy soils.
- **Land Preparation:** Prepare planting pits or seedbeds.
- **Planting Time:** Early spring or rainy season.
- **Spacing:** 3-4 m spacing.
- **Fertilizer:** Organic manures and balanced NPK fertilizers support growth.
- **Weed Control:** Keep area free from weeds during establishment.

**Propagation**

- Propagated by seeds, stem cuttings, or root suckers.
- Stem cuttings are most common and effective.

**Nursery Management**

- Cuttings planted in nursery beds or pots with fertile soil.
- Maintain moisture and protect from pests.

### 6.5.6 Koiralo

Koilaro or drumstick tree is a fast-growing, drought-tolerant tree with highly nutritious leaves rich in protein, vitamins, and minerals. It is widely used as fodder for livestock and has numerous nutritional and medicinal uses.

**Cultivation Practices**

- **Climate and Soil:** Thrives in tropical and subtropical climates; tolerates poor and drought-prone soils. Prefers well-drained sandy loam soils.
- **Land Preparation:** Clear land and prepare planting pits or beds.
- **Planting Time:** Early rainy season is ideal.
- **Spacing:** 2-3 m spacing.
- **Fertilizer:** Organic manures recommended; chemical fertilizers applied based on soil test.
- **Weed Control:** Control weeds during early growth.

**Propagation**

- Propagated by seeds or stem cuttings; cuttings provide quicker establishment.

**Nursery Management**

- Seeds soaked overnight before sowing.
- Cuttings planted in nursery beds or bags with fertile soil.
- Maintain adequate moisture and protect seedlings.

## Exercise

**Choose the correct answer from the given alternatives.**

1. At what stage is maize best harvested for fodder to ensure maximum nutritional value?

   a. Dough stage  b. Milk stage

   c. Flowering stage  d. Seed setting stage

2. Which of the following fodder crops is a summer annual that thrives in hot, humid climates and is often intercropped with legumes?

   a. Oat  b. Teosinte

   c. Guinea grass  d. Lucerne

3. Which grass is commonly cultivated during the winter season and is rich in protein and digestible nutrients?

   a. Napier  b. Bajra

   c. Oat  d. Para grass

4. Which fodder crop requires frequent cutting and is often grown as a ratoon crop in tropical climates?

   a. Bajra  b. Napier  c. Oat  d. Maize

5. Which grass is known for its salt tolerance and is often used in waterlogged or marshy areas?

   a. Guinea  b. Seteria  c. Paspalum  d. Teosinte

6. Which annual legume is a high-protein forage, usually grown in summer and often used for green manuring and soil improvement?

   a. Pea  b. Berseem  c. Cowpea  d. Stylosanthes

7. Berseem grows best in which type of climate?

   a. Hot and dry  b. Cold and dry

   c. Cool and moist  d. Very hot and humid

8. Which annual legume fodder can fix atmospheric nitrogen and is suitable for growing in loamy soil?

a. Joint vetch
b. Paspalum
c. Seteria
d. Molasses grass

9. Which perennial legume is drought-resistant and commonly grown in dryland areas for year-round fodder?

a. Berseem
b. Lucerne
c. Pea
d. Cowpea

10. Which of the following perennial legumes is known for its excellent soil-binding properties and suitability in hilly terrain?

a. Stylosanthes
b. Oat
c. Guinea grass
d. Bajra

11. Forage peanut is particularly well-suited for.....

a. Cold climates with low rainfall
b. Sandy soils with good drainage
c. Wetlands and paddy fields
d. Heavy clay soils

12. Which fodder tree is fast-growing, nitrogen-fixing, and commonly used for both green fodder and firewood?

a. Badahar
b. Tanki
c. Ipil-Ipil
d. Kabro

13. Which fodder tree is traditionally propagated by seed and found commonly in mid-hills of Nepal?

a. Kabro
b. Kutmiro
c. Kimbu
d. Para grass

14. What is a major benefit of cultivating fodder trees like Badahar and Kabro?

    a. They grow only in deserts

    b. They require constant irrigation

    c. They provide green fodder during the dry season

    d. They reduce the protein content in feed

15. Which fodder tree is also cultivated for its fruit in addition to being used as livestock feed?

    a. Tanki  b. Koiralo

    c. Kimbu (Mulberry)  d. Seteria

16. Which is annual legume forage?

    a. Berseem  b. Oat

    c. Sudan  d. Lucen

    e. Sudan  f. All

## Write short answer to the following questions.

1. Name any two perennial fodder grasses.
2. What is the primary advantage of cultivating Napier grass?
3. Name one legume that can be used both as a fodder crop and for green manuring.
4. What type of soil is best for cultivating forage peanut?
5. Name any two perennial legume fodder crops.
6. Name one fodder tree that also provides fruit.
7. What are two benefits of cultivating fodder trees on farms?

## Write long answer to the following questions.

1. Classify annual, perennial legumes and non-legumes fodder and forage.
2. How do you cultivate different fodder (all perennial, annual and seasonal).
3. What are the roles of fodder trees in sustainable livestock farming? Explain

with examples of Ipil-Ipil, Tanki, Badahar, Kimbu, Kabro, and Kutmiro, including their cultivation and uses.

4. Why are perennial legume crops and fodder trees essential in regions with limited green fodder availability? Support your answer with examples and reasons.

# Unit 7

# Pasture/Rangeland Management

## 7.1 Importance and Scope of Pasture/Rangeland Management in Nepal

Pasture and rangeland management is vital in Nepal because livestock farming forms a significant part of rural livelihoods and the national economy. With about 70% of agricultural land classified as pasture or rangeland, these areas provide crucial grazing resources for millions of animals, including cattle, buffalo, goats, and sheep.

**Importance**

- Ensures sustainable forage production and availability throughout the year.
- Maintains soil health and prevents erosion, especially on hilly and mountainous terrain.
- Supports biodiversity and ecological balance in fragile ecosystems.
- Enhances livestock productivity by providing quality feed, which influences milk, meat, and draft power output.
- Contributes to poverty alleviation by supporting smallholder farmers and pastoral communities.
- Scope:
- Improvement of degraded rangelands through re-seeding, controlled grazing, and fertilization.
- Development of integrated pasture-livestock systems to maximize efficiency.
- Conservation of native forage species adapted to Nepal's diverse agroecological zones.
- Policy formulation and community-based management approaches to sustain grazing resources.

## 7.2 Animal Feeding Systems and Grazing Systems in Nepal

Nepal's livestock feeding is predominantly based on grazing, supplemented by crop residues, agro-industrial by-products, and harvested fodders. Feeding systems vary by agro-ecological zones:

- **Free grazing:** Animals graze common pastures and fallow lands, mainly in hill and mountain regions.
- **Cut-and-carry:** Common in the Terai and mid-hills, where fodder is harvested and fed to animals.
- **Mixed feeding:** Combination of grazing and stall feeding using crop residues and fodder.

**Grazing Systems**

- **Continuous grazing:** Animals graze the same pasture continuously, often leading to overgrazing and pasture degradation.
- **Rotational grazing:** Pasture is divided into paddocks; animals graze one section while others recover, promoting sustainable use.
- **Seasonal grazing:** Grazing intensity and location change with seasons, utilizing different pastures throughout the year.

## 7.3 Plant Poisoning in Pasture and Their Management

Common Toxic Plants in Nepal's Pastures: Some plants contain toxic compounds that can cause poisoning in livestock, such as:

- Lantana camara (Lantana): Causes photosensitization and liver damage.
- Rhododendron spp.: Contains grayanotoxins affecting the nervous system.
- Euphorbia spp.: Irritant sap causing gastrointestinal upset.
- Datura spp.: Toxic alkaloids causing nervous system depression.

**Management:**

- Identification and removal of toxic plants from grazing areas.

- Providing adequate alternative forage to reduce ingestion of poisonous plants.
- Educating farmers and herders to recognize toxic plants and symptoms of poisoning.
- Use of fenced grazing areas to control access.
- In cases of poisoning, prompt veterinary treatment is essential.

## 7.4 Factors Affecting Pasture/Rangeland Management

Pasture and rangeland management is influenced by a combination of environmental, ecological, and human-related factors. These factors determine the productivity, sustainability, and ecological balance of grazing lands. Effective management requires understanding how various elements such as climate, soil quality, grazing intensity, land use practices, and socio-economic conditions interact and impact pasture health. In Nepal's diverse topography and climate zones, these factors play a critical role in shaping the success of pasture-based livestock systems.

**Biophysical Factors**

- **Climate:** Rainfall and temperature influence forage growth and species composition.
- **Soil:** Soil fertility, texture, and drainage affect pasture productivity.
- **Topography:** Slopes and altitude determine grazing patterns and erosion risk.

**Anthropogenic Factors**

- **Grazing pressure:** Overstocking leads to overgrazing and degradation.
- **Land use change:** Conversion of rangelands to croplands or settlements reduces pasture area.
- **Fire management:** Controlled burning can improve forage but uncontrolled fires cause damage.
- **Socio-economic factors:** Farmers' knowledge, resource availability, and

policies impact management practices.

**Ecological Factors**

- **Invasive species:** Non-native plants can reduce forage quality and biodiversity.
- **Wildlife interactions:** Competition and disease transmission may affect pasture health.

## Exercise

**Choose the correct answer from the given alternatives.**

1. What is a key benefit of effective pastureland management in Nepal?
   a. Increases urban development
   b. Reduces livestock productivity
   c. Enhances livestock feed availability
   d. Promotes deforestation

2. Why is pastureland management important for rural communities in Nepal?
   a. It reduces milk production
   b. It increases the cost of animal farming
   c. It ensures year-round supply of fodder
   d. It prevents the use of indigenous breeds

3. Which of the following best describes the scope of pastureland management in Nepal?
   a. Only in high-altitude regions
   b. Only for cattle farming
   c. Across diverse climatic zones and livestock systems
   d. Only for commercial farming

4. Which of the following is a common grazing system in Nepal?
   a. Hydroponic grazing
   b. Continuous grazing
   c. Aerial feeding
   d. Indoor silage feeding only

5. Which feeding practice involves feeding animals in a fixed area with harvested forage?
   a. Open grazing
   b. Stall feeding
   c. Rotational grazing
   d. Free-range grazing

6. What is one advantage of rotational grazing over continuous grazing?
   a. Increases soil erosion
   b. Encourages overgrazing
   c. Improves pasture recovery and regrowth
   d. Requires less land area

7. Which of the following is a commonly found poisonous plant in Nepalese pasturelands?
   a. Berseem
   b. Lucerne
   c. Lantana camara
   d. Guinea grass

8. What is the best way to manage poisonous plants in pasturelands?
   a. Increase grazing time
   b. Introduce more livestock
   c. Identify and remove toxic species regularly
   d. Ignore them if animals avoid them

9. Which symptom might indicate livestock have ingested a poisonous plant?
   a. Increased milk yield
   b. Bright eyes and high energy
   c. Diarrhea, drooling, or staggering
   d. Normal feeding behavior

10. Which of the following is a major factor affecting rangeland degradation in Nepal?
   a. Controlled grazing
   b. Reforestation
   c. Overgrazing and encroachment
   d. Livestock population decline

11. What role does climate play in pastureland management?
    a. No role at all
    b. Consistently improves pasture productivity
    c. Influences forage growth and seasonal availability
    d. Only affects crops, not pasture

12. Which human activity negatively impacts pastureland health in Nepal?
    a. Conservation farming
    b. Rotational grazing
    c. Uncontrolled grazing and deforestation
    d. Use of improved forage species

13. Which of the following is not a factor influencing pastureland management?
    a. Soil fertility
    b. Livestock density
    c. Availability of mobile phones
    d. Seasonal rainfall pattern

**Write short answer to the following questions.**

1. What is the main purpose of pastureland management in Nepal?
2. Name two benefits of proper rangeland management.
3. What is meant by stall feeding?
4. Define rotational grazing.
5. List two grazing systems commonly practiced in Nepal.
6. What is one symptom animals may show after eating poisonous plants?
7. Mention any two poisonous plants commonly found in Nepalese pasturelands.
8. How can poisonous plants be controlled in grazing areas?
9. What is the impact of overgrazing on pasturelands?

10. State two human activities that lead to pasture degradation.
11. Name two factors that influence pasture productivity.
12. Why is rotational grazing better than continuous grazing?

## Write long answer to the following questions.

1. Discuss the importance and scope of pastureland management in Nepal. How does it support rural livelihoods and livestock production?
2. Explain the different animal feeding and grazing systems practiced in Nepal. Compare stall feeding with open grazing and rotational grazing.
3. Identify common poisonous plants found in Nepalese pastures and explain their effects on livestock. How can these issues be managed?
4. List and explain the major factors affecting pasture or rangeland management in Nepal. Include both natural and human-induced factors.
5. Describe different types of pasture in detail.
6. Enlist the poisoning plants with their different characteristics, effects and solutions.

# Unit 8

# Conservation of Fodder/ Forages

## Introduction

Conservation of fodder and forages refers to the process of preserving green feed resources for use during periods of scarcity, such as dry seasons or winter. In livestock-based agricultural systems like those in Nepal, seasonal variation in forage availability often leads to feed shortages. Therefore, conservation techniques such as **hay making**, **silage preparation**, and **fodder block production** are essential to ensure a continuous supply of nutritious feed throughout the year. Proper conservation not only reduces dependence on costly commercial feeds but also enhances animal health, productivity, and farm sustainability.

## 8.1 Hay Making

**Hay** is the dried aerial part (mainly stems and leaves) of **grasses or legumes** harvested at the proper stage of growth and preserved by drying to retain its nutritive value. It is mainly used as a **roughage source** during the dry season or when fresh forage is unavailable.

### Importance of Hay

- Provides feed during off-season or drought.
- Helps maintain consistent nutrition for livestock.
- Economical and easy to store and transport.
- Reduces pressure on grazing lands.

**Types of Hay**

1. **Legume Hay**
   - Made from leguminous crops like **Berseem**, **Lucerne (Alfalfa)**, **Stylosanthes**, **Cowpea**.
   - **High in protein** and calcium.
   - Best for dairy animals and young stock.
2. **Grass Hay**
   - Made from cereal or pasture grasses like **Napier**, **Setaria**, **Timothy**, **Oat**, **Ryegrass**.
   - Lower in protein but rich in fiber.
   - Suitable for maintenance rations.
3. **Mixed Hay**
   - A combination of **grasses and legumes**, offering a **balanced nutrient profile**.
   - Improves palatability and feed intake.

***Fig 22: Hay***

**Stages of Harvesting for Hay**

- **Legumes:** At early bloom stage for best protein and digestibility.
- **Grasses:** At **boot stage to early heading** when nutrient content is highest.

**Process of Hay Making**

1. **Harvesting**
   - Forage should be cut at the correct stage of maturity (before it becomes too fibrous).
   - Cut during **dry sunny weather** for optimal drying.
2. **Drying (Curing)**
   - The cut forage is left in the field to **lose moisture** (aim for <15% moisture).
   - Regular turning is done to ensure **even drying** and prevent spoilage.
   - Use **hay tedders** or manually turn with forks.
3. **Collection and Baling**
   - Once dried, hay is collected and may be **baled** using balers into compact forms (square or round bales).
   - Hand tying into bundles is also common in rural areas.
4. **Storage**
   - Store in **dry, well-ventilated sheds** or stack above ground on bamboo or pallets.
   - Protect from **rain, rodents, and insects**.
   - Cover with tarpaulin or thatch.

**Precautions in Hay Making**

- Avoid **raining** during drying—moisture causes mold and nutrient loss.
- Prevent **over-drying** as it causes leaf shattering (especially in legumes).
- Harvest **clean fields** to avoid contamination with weeds, dust, or soil.

## 8.2 Silage Making

**Silage** is a type of preserved green fodder made by **fermenting** fresh forage crops (grasses, legumes, or cereals) under **anaerobic (oxygen-free)** conditions. The fermentation process converts sugars into **lactic acid**, which preserves the fodder and maintains its nutritional quality. Silage is an important method for conserving **succulent green fodder** for feeding during dry seasons or feed shortages.

### Importance of Silage

- Preserves the **nutritional quality** of fresh fodder.
- **Palatable and digestible** for livestock.
- Reduces seasonal feed shortages.
- Suitable for **large-scale livestock farming**.
- Can be stored for long periods without spoilage if prepared properly.

### Crops Suitable for Silage Making

- **Cereal fodders**: Maize, Sorghum, Oat, Pearl millet (Bajra), Hybrid Napier
- **Leguminous fodders**: Berseem, Cowpea (mixed with cereal crops)
- **Grass species**: Guinea grass, Setaria, Napier

### Types of Silage

1. **Maize Silage**
   - Most commonly used.
   - High energy content and excellent fermentation quality.
2. **Sorghum Silage**
   - Drought-resistant, good for dry areas.
3. **Grass Silage**
   - From grasses like Napier or Setaria; must be wilted to reduce moisture.

**4. Legume Silage**

- High protein, but harder to ferment alone due to low sugar; best when mixed with cereals.

***Fig 23: Silage***

**Ideal Moisture Content**

- **65–70%** moisture (30–35% dry matter) is ideal.
- Too wet: risk of poor fermentation and spoilage.
- Too dry: difficult compaction and air entry.

**Process of Silage Making**

**1. Harvesting**

- Harvest forage at the right stage:
- **Maize/Sorghum:** At **milk to early dough stage**
- **Grasses/Legumes:** Pre-flowering to early flowering stage
- Chop the forage into **2–4 cm** lengths for better packing and fermentation.

2. **Wilting (if needed)**
   - Wilt the forage under the sun for a few hours if too moist (>70%).
3. **Filling the Silo**
   - Use a **silo pit, trench, drum, or plastic bags**.
   - Layer the chopped fodder and **press firmly** to remove air.
   - Optional: Add **molasses (2–5%)** to improve fermentation.
   - Add **common salt or urea** if desired to improve nutrition.
4. **Sealing**
   - Cover tightly with **plastic sheets** and **soil or weights** to ensure airtight conditions.
   - Prevents air entry and supports anaerobic fermentation.
5. **Fermentation**
   - Allow 21–30 days for proper fermentation.
   - Well-prepared silage has a **pleasant sour smell**, olive-green to yellow color, and firm texture.
6. **Storage and Feeding**
   - Store in a dry, shaded area.
   - Once opened, use daily and keep the surface **well-covered** to avoid spoilage.

**Advantages of Silage**

- Nutrient-rich and highly digestible.
- Minimal dry matter loss if done properly.
- Saves labor and time during feed shortage periods.
- Can utilize excess green fodder during peak season.

**Precautions**

- Avoid making silage from **immature** or **over-mature** plants.
- Do not allow **rainwater** to enter the silo.
- Ensure complete **airtight sealing**.
- Use **clean and dry** storage containers to prevent mold or contamination.

## Exercise

**Choose the correct answer from the given alternatives.**

1. What is the main purpose of making hay?
   a. To increase seed production
   b. To preserve green fodder for future use
   c. To extract oil from grass
   d. To make bedding for animals

2. Hay is made primarily from.....
   a. Grains
   b. Roots
   c. Green forage crops
   d. Fruits

3. Which of the following is a suitable crop for hay making?
   a. Paddy
   b. Berseem
   c. Sugarcane
   d. Potato

4. The best time to harvest forage for hay is.....
   a. When leaves are yellow
   b. At seed setting stage
   c. At early flowering or pre-bloom stage
   d. After full maturity

5. What is the ideal moisture content in forage at the time of hay storage?
   a. 10–15%
   b. 60–70%
   c. 30–40%
   d. 50–60%

6. One of the signs of poor hay quality is.....
   a. Green color and good aroma
   b. Presence of mold and black spots
   c. Soft texture and leafy
   d. Sweet smell and uniform color

7. Which method is commonly used for drying hay in small-scale farms?

a. Deep freezing
b. Oven drying
c. Sun drying on the ground
d. Fermentation

8. What is the primary risk if hay is stored with high moisture content?

a. It may become too sweet
b. It may turn yellow
c. It may ferment and catch fire
d. It will dry faster

9. What is the purpose of silage making?

a. To increase water content in feed
b. To preserve green fodder through fermentation
c. To reduce the fiber in roughages
d. To increase hay production

10. Which of the following crops is most suitable for silage making?

a. Maize
b. Wheat
c. Pea
d. Oatmeal

11. The ideal moisture content for silage preparation is.....

a. 5–10%
b. 10–20%
c. 60–70%
d. 90–100%

12. Which substance is produced during silage fermentation that helps preserve the feed?

a. Acetic acid
b. Hydrochloric acid
c. Lactic acid
d. Citric acid

13. What is a common method used for making silage on farms?

a. Sun drying
b. Underground pit (silo pit)
c. Baking
d. Spraying chemicals

14. Good silage should have.....

a. A burnt smell

b. A sour, sweet smell and greenish color

c. Dry and brittle texture

d. White mold

15. What is the effect of poor compaction during silage making?

a. Promotes fermentation

b. Increases nutrient retention

c. Leads to air entry and spoilage

d. Enhances palatability

## Write short answer to the following questions.

1. What is hay?
2. Why is hay making important for livestock farming?
3. Name two crops commonly used for hay making.
4. What are the signs of good quality hay?
5. What is silage?
6. Why is silage making practiced by farmers?
7. Name any two crops suitable for silage making.
8. What is the ideal moisture content for silage making?
9. What are the signs of good quality silage?
10. How do you prepare hay?
11. Write the procedure for making silage and highlight its importance in feeding.
12. Differentiate between hay and silage

## Write long answer to the following questions.

1. Describe the process of hay making. Include steps from harvesting to

storage and mention factors affecting hay quality.

2. Describe the step-by-step process of silage making. Mention ideal crops, moisture content, fermentation, and storage methods.
3. Compare and contrast hay and silage. Highlight differences in preparation, storage, usage, and nutritional value.
4. Explain the biochemical process that occurs during silage fermentation. What is the role of lactic acid bacteria?
5. Suggest ways to improve the adoption of hay and silage making among smallholder farmers in Nepal.

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