RWANDA POLYTECHNIC

TVET LEVEL II

AGRICULTURE

Ruminant Farming

TRAINEE MANUAL

RWANDA POLYTECHNIC

Approved by: Workforce Development Authority

USAID FROM THE AMERICAN PEOPLE

EDC Education Development Center

2020

Acknowledgements

Rwanda Polytechnic (RP) would like to officially recognize all parties who contributed actively to the preparation of the Trainer and Trainee manuals of this module. We wish to extend our thanks to various organizations such as Workforce Development Authority (WDA), EDC through its USAID Huguka Dukore Akazi Kanoze (USAID - HDAK), TVET schools, Private Industries, GIZ Hanga Ahazaza Project and other individuals who greatly contributed from the initial concept towards publication of this training manual.

Under Rwanda Polytechnic (RP) supervision and involvement

Under Workforce Development Authority (WDA) guiding policies and directives

With funding provided by USAID through Huguka Dukore Akazi Kanoze (HDAK) project

And with technical support by Education Development Center (EDC) through local and international USAID HDAK experts

Production Team

Authoring and Review

Mrs. Bernardine Uwumukiza
Mrs. Yvonne Mukayiranga
Mrs. Joyeuse Marie Nyiraneza

Conception, Adaptation, Review and Editing

Mr. Felix Ntahontuye
Mr. Jean Marie Vianney Muhire
Mrs. Elizabeth Miller Pittman
Ms. Grace Pettey

Formatting, Graphics and Infographics

Mr. Albert Ngarambe
Mr. Simon Pierre Abayiringira

Technical Support

USAID Huguka Dukore Akazi Kanoze (HDAK) project
implemented by Education Development Center (EDC)

RUMINANT FARMING

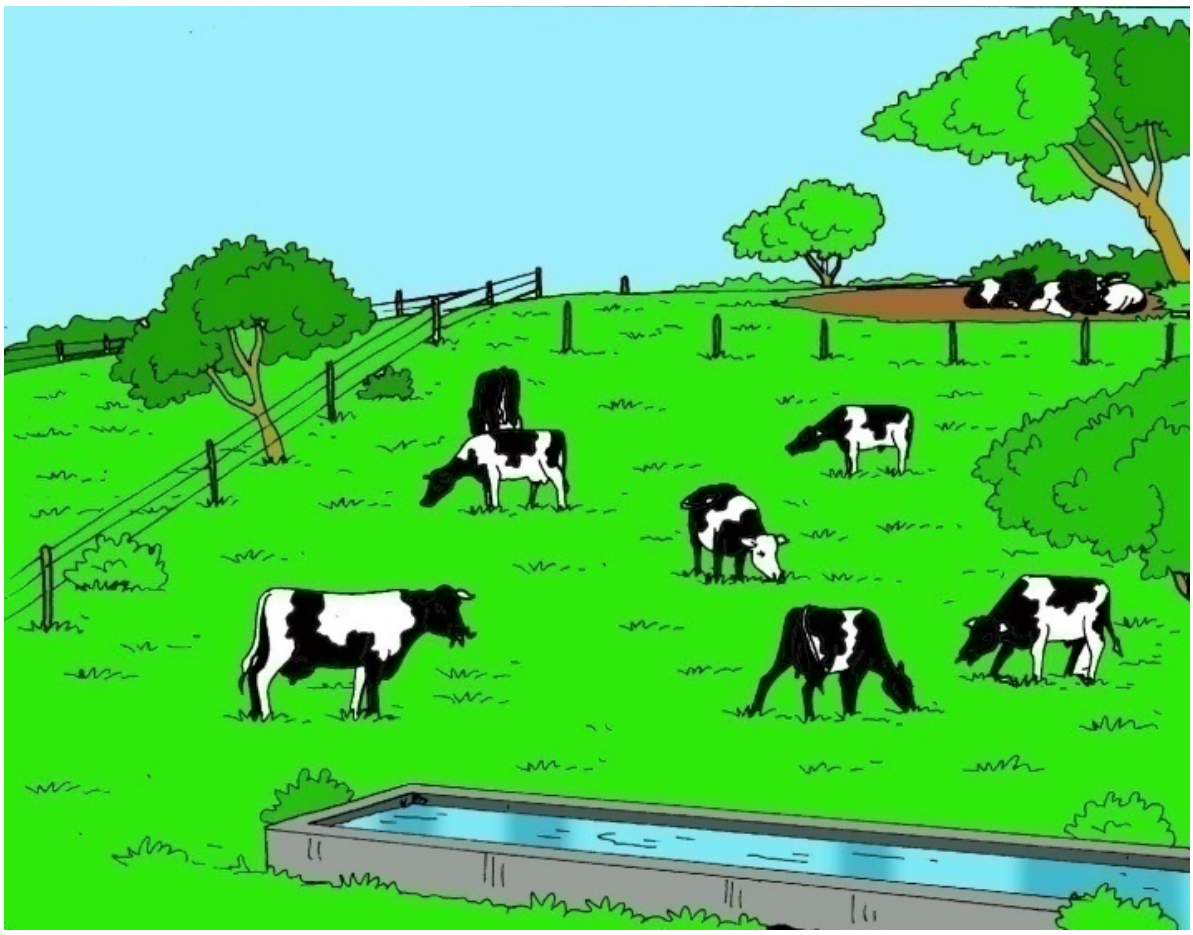
Unit 1: Planting fodder crops and pasture maintenance

Unit 2: Ruminant management practices

Unit 3: Ruminant reproduction assistance

Unit 4: Milking operations

Unit 1: Planting fodder crops and pasture maintenance



Topics

1.1 Planting fodder crops

1.2 Harvesting and post-harvest of fodder crops

1.3 Pasture maintenance

Unit Summary:

This unit describes skills, knowledge, and attitudes required to plant fodder crops. At the end of this unit, trainees will be able to plant fodder crops, harvest and post- harvest fodder crops, maintain a pasture, and establish fodder crops under frequent supervision.

Self-Assessment: Unit 1

1. Look at the illustration. What is happening? What do you think this unit will be about? What topics might be covered?

2. Fill in the self-assessment below.

There are no right or wrong ways to answer this assessment. It is for your own use during this unit. The trainer will read a skill that is listed in the left column. Think about yourself: do you think you can do this? How well? Read the statements across the top. Put a check in column that best represents your situation. At the end of this unit, we'll take this assessment again.

My experience Knowledge, skills, and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
Classify forage					
Describe fodder crops					
Prepare land for fodder crops					
Plant fodder crops					
Describe how and when to harvest fodder crops					
Make hay					
Make silage					
Renew pasture					
Establish paddocks and apply rotation in pastures					
Maintain infrastructures of pasture					

Topic 1.1: Planting fodder crops

Key Competencies:

Knowledge	Skills	Attitudes
1. Identify seeds to be planted	**1.** Select fodder crop species to plant	**1.** Detail-oriented
2. Determine planting season based on climatic conditions	**2.** Describe best practices for forage planting	**2.** Patience
3. Describe planting methods of forage	**3.** Plant fodder crops	**3.** Responsibility

Getting Started: What do we know and where are we going?

Topic 1.1 Task 1:

1. Separate into small groups and choose a secretary for your group.

2. Go outside and each bring a plant back inside.

3. Describe and classify the plants in your group according to their physical characteristics. Your group secretary should take notes on your findings.

   a. Describe each plant's colour, shape, size, and parts.

   b. Determine if each plant is used for animal feed or not.

4. Secretaries share their group's responses and discuss as a class. Clarify any misconceptions about parts of plants and the difference between fodder crops and forage crops.

5. Review the Key Competencies table, which includes the knowledge, skills, and attitudes you will gain by the end of this topic.

Problem Solving Activity

Topic 1.1 Task 2:

1. Read the scenario and answer the questions that follow with your group from the previous activity:
   A farmer of ruminants needs to plant fodder crops and he needs technical assistance. Ask trainees to answer following questions:
   a. How do you select a good fodder crop to plant?

   b. Explain the difference between:
      - Forage and fodder crops
      - Groups of fodder crops: grasses (roughage/cereals) and legumes

   c. Give examples of cereal and legumes.

   d. Predict the different planting methods for fodder crops.

2. After your discussion, come together as a class and compare your answers.

3. With the class, read through **1.1 Key Facts**.
   a. As you read, verify your answers from the discussion.

   b. Write a star (*) any information you predicted incorrectly and any information you did not include.

1.1 Key Facts

- **Fodder crops:**
  - High yielding, high quality crops grown specifically for providing feed in intensive livestock grazing systems.
  - Cut-and-carried to the animals.
  - Good impact with both zero-grazers and open-grazers.

- **Characteristics of high-quality fodder crops:**
  - Adaptable to the climate
  - Stimulate animals' appetites
  - Produce high yield
  - Resistant to diseases and disasters

- **Forage crops:**
  - Plant material grown to be eaten by grazing livestock
  - Natural pasture is a forage but is not grown as a crop, so is termed forage, not a forage crop.
  - Produce much higher yields than natural forages and because they produce high yields.

- **Planting season:**
  - Plant during rainy season preferably
  - Should remain productive during dry seasons
  - Avoid:
    - Small land area
    - Low yielding fodder crops
    - Poor soil fertility and irrigation practices
    - Insects, diseases, and weeds
    - High amount of chemical fertiliser
    - Overgrazing

- **Identification of seeds:**
  - Two main groups of fodder crops:[1]

Grasses (Graminaceae) Species	Legumes (Leguminous) Plants
- **Pennisetum purpureum (Napier/Elephant Grass)** ▪ Most popular fodder grass in East Africa ▪ Recommended for zero-grazing systems ▪ Can grow 2-3 meters high ▪ Grows quickly and densely ▪ Grows well in well-drained, fertile soil with a lot of rain ▪ Use manure or inorganic fertilisers - **Tripsacum andersonii (Guatemala Grass)** ▪ Grows well in fertile, well-drained soils	- **Calliandra *spp*** ▪ Common tree species in East Africa ▪ Grows well in well-drained, fertile soils ▪ Avoid acid soils and frost ▪ Grow to be 4-6 meters tall ▪ Prune every 8-12 weeks ▪ Can be planted along slopes of terraces - **Desmodium *spp*** ▪ Greenleaf and Silverleaf species ▪ Grows well in different soil qualities and climates

[1] Holmström, L. (2013). *Fodder to ruminants within agroforestry systems in Rwanda: Species and management*. Swedish University of Agricultural Sciences. https://stud.epsilon.slu.se/5790/1/holmstrom_l_130628.pdf

▪ Lives for several years ▪ Grows to 3 meters high ▪ Avoid drought areas ▪ Good for erosion control ▪ Cut 6 months after planting	- **Leucaena *spp*** ▪ Small legume tree ▪ Grows up 1,600 meters above sea level ▪ Grows well in well-drained and fertile soils ▪ Grows well with high rainfall ▪ Avoid acid soils

- **Preparation of the land:**
  - **Select area**
    - At the boundaries: Land use efficiency
    - Along terraces/slopes between terraces to increase food production and controls soil erosion on the hills
  - **Seedbed**
    - Remove pests, diseases, and weeds.
    - Plough or dig (if hand tools are used).
    - Harrow to break large soil clods into smaller ones.
    - Roll the ground to firm the soil.
  - **Fodder banks**
    - Specific area to grow high quality fodder
    - Secures feed supply even during dry season
    - Plant grasses between trees/legumes to maximise production
  - **Fertilization**
    - Organic manure
    - Inorganic fertilisers
    - Liming
    - pH control

- **Establish plant in land:**
  - **By seed**
    - Consider: true variety, seed quality, seed dormancy.
    - Mechanical scarification.
    - Acid treatment.
    - Hot water treatment and inoculation.
    - Seeds may be planted in two ways: broadcasting or sowing in line.

- **By vegetative parts**
  - Plants reproduce themselves from parts, such as tuft splits and stem cuttings.
  - By seedlings
  - Raise seedlings two months ahead of the rainy season using plastic bags in a nursery house.

Guided Practice Activity

Topic 1.1 Task 3:

1. Your next task is to work in small groups (2-3 people) to research specific information about fodder crops in Rwanda. You may use the resources available, including the internet, reference books, **1.1 Key Facts**, and other school staff.

2. Record your findings in the chart below. Ask the trainer for guidance as needed.

3. After researching, present your group's findings. Remember that your findings must apply to ruminant farming in Rwanda (not somewhere else). Be sure to cite your sources and come to a full agreement with the other groups on the correct information.

Fodder Crop	Grass or Legume	Planting Method	Space Between Crops	Soil Characteristics
Pennisetum purpureum				
Calliandra *spp*				
Desmodium *spp*				
Tripsacum andersonii				
Leucaena *spp*				

4. You will confirm at least some of your research in the next activity, when you visit a ruminant farm.

Application Activity

Topic 1.1 Task 4:

1. Visit a ruminant farm and greet the farmer.

2. Take a tour of the farm and identify the fodder crops you see. Record your findings in the chart below:

Fodder Crop	Grass or Legume	Planting Method	Space Between Crops	Soil Characteristics

3. Ask the farmer for guidance in identifying the crops as well as the other information about each one. Refer to **1.1 Key Facts** and your research from the previous activity as well.

4. If possible, assist the farmer in planting new fodder crops on the farm.

5. After the visit, discuss your experience as a class using the following questions:
   a. What did you learn?
   b. How did your research compare to your experience?
   c. What was the same?
   d. What was different?

Points to Remember

- All legumes have similar fruits, called pods.
- Select fodder crops with high productivity, resistance to diseases, and appetitive to animals.

Formative Assessment

After carefully reading the following items, answer the following questions individually:

1. List three factors that should be avoided when planting fodder crops:
   1.
   2.
   3.

2. List two characteristics of high-quality fodder crops:
   1.
   2.

3. Explain the difference between fodder crops and forage crops.

4. Determine if the following fodder crops are grasses or legumes:
   a. Calliandra:
   b. Tripsacum andersonii:
   c. Desmodium:
   d. Leucaena:
   e. Pennisetum purpureum:

Topic 1.2: Harvesting and post-harvesting fodder crops

Key Competencies:

Knowledge	Skills	Attitudes
1. Determine when to harvest fodder crops	**1.** Identify fodder crops at harvesting time	**1.** Detail-oriented
2. Describe how harvest fodder crops	**2.** Harvest fodder crops	**2.** Precise
3. Describe hay-making and silage-making processes	**3.** Conserve fodder crop	**3.** Responsibility

Getting Started: What do we know and where are we going?

Topic 1.2 Task 1:

1. Separate into small groups (2-3 people). Discuss the following points:

   a. What are the problems we have with animal feeding in Rwanda?

   b. What causes these problems?

   c. What can we do to correct the problem?

2. Choose a presenter from your group to share your responses. Discuss your ideas as a class.

3. Review the Key Competencies table, including the knowledge, skills, and attitudes you will gain by the end of this topic.

Problem Solving Activity

Topic 1.2 Task 2:

1. You have been asked to help a group of local farmers groups to harvest and conserve of fodder crops. With a partner, discuss the following questions based on **Topic 1.1** and your own experiences:

a. How do you know when to harvest fodder crops?

b. Do you harvest grasses and legumes at different times? Explain your responses.

c. What could you do if you have additional fodder crops and want to conserve them for later?

2. Share your ideas from the discussion. Compare your different ideas and explain your reasoning.

3. As a class, read through **1.2 Key Facts**. Do the following as you read:
- ❖ Star the information that you discussed with your partner from **Question 1.**
- ○ Circle the information that is new or that you have more questions about.

4. After reading **1.2 Key Facts,** discuss again with your partner:

a. What is the difference between hay-making and silage-making?

b. Describe the processes of making hay and silage <u>in your own words</u>. Do not read directly from **1.2 Key Facts.**

5. Come together again to share your answers and clarify any misunderstandings.

1.2 Key Facts

- **Harvesting fodder crops:**
  - Depends on the environmental conditions and the growth of the plants.
  - **Grasses**
    - When grasses are 2-3 cm high during rainy season
    - When grasses are 10 cm high during dry season
    - First cut after 8-10 weeks
  - **Legumes**
    - When trees are 50-150 cm high
    - Cut every 6-18 weeks
    - Cutting frequently increases nutritional value, but decrease life span of trees
  - **Methods**
    - Manual: Using machetes
    - Machine Using tractors

- **Fodder conservation:**
  - Hay production: fodder conserved by drying
  - Silage production: fodder conserved through the wet method

- **Hay:**
  - Reduces water content so that it can be stored without rotting or becoming mouldy.
  - Reducing the moisture content slows down the rate of growth of spoilage from microorganisms.
  - Large-leaf plants take longer to be made into hay than fine-leaved plants.
  - Desmodium makes good hay; Pennisetum does not.

- **Hay production:**
  - Harvest the fodder for haymaking when the crop has attained 50% flowering.
  - Fodder should be harvested after 2 to 3 days of dry weather.
  - Dry under shade so that the dried fodder retains its green colour, which is an indicator of quality.
  - Turn the fodder using a farm fork to ensure that it is dried.
  - Check the dryness by trying to break the stem. If it bends too much without breaking, there is still too much water.
  - Mix legumes and grasses to make better-quality hay.

- **Baling hay:**
  - To organize hay into a single, compact area.
  - Allows more material to be stored in a space.
  - A good estimate of the amount stored makes feed budgeting easier.
  - Can be manual or mechanized--manual is more economical for small-scale dairy farmers.[2]

- **Characteristics of high-quality hay:**
  - Leafy and greenish colour
  - No foreign material mixed with it, such as rocks
  - No smell

- **Silage:**
  - A method of preserving forage through anaerobic lactic fermentation.
  - The lack of oxygen and a sufficient acidity blocks the activity of various bacteria and fungi

[2] Rwanda Education Board. (n.d.). *Unit 4: Fodder*. REB e-Learning Platform. https://elearning.reb.rw/course/view.php?id=275§ion=4

- **Silage production:**
  - Applied both to grasses and to maize and possibly to food crop by-products such as pulp and dried spent grains.
  - Ensure that grass has a low of sugar and relatively low in nitrogen.
  - During silage, fodders are stored into a silo.
    - A silo is an airtight place or for preserving green feed for future feeding on the farm.
    - Silo must also be made into plastic bag that we can buy.
    - Silo must allow compaction and be airtight.

- **Silage process:**
  - Chop the wilted material to be ensiled into pieces--not more than 2.5 cm long.
  - Sprinkle the chopped material with a molasses and water mixture
    - For every sack use 1 litre of molasses mixed with 2–3 times water.
    - This is especially for material like Napier grass that has low sugar content.
    - Maize bran or cassava flour can be added to improve the carbohydrate (energy) content.
  - Place the material into the silo and compress it well. The compaction is usually the most neglected step in filling silos. A dense compaction reduces the losses of dry matter and heating problems and storage costs.
  - Fill in 1 to 2 days. By filling the silo as quickly as possible, we minimise the exposure to air and rain.
  - When filled, cover the top of the silo with a sheet of plastic or stones and cover with the soil in order to keep out water and air.
  - Leave the silage for a few months before using it.

- **Characteristics of high-quality silage:**
  - Colour: A yellowish green colour.
    - A dark green colour indicates butyric acid.
  - Smell: Should smell fruity and acidic, but pleasant.
    - Smell of vinegar indicates acetic acid excess which means it was not compacted enough.[3]

[3] International Livestock Research Institute, German Cooperation, & Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). (n.d.). *How to conserve fodder*. https://cgspace.cgiar.org/rest/bitstreams/187186/retrieve

Guided Practice Activity

Topic 1.2 Task 3:

1. Read the following scenario and answer the questions with your small group from **Topic 1.2 Task 1.**

   Ange has a ruminant farm in the Eastern province. During the rainy season, she grew more fodder crops than she needs. She wants to conserve some of them to feed her animals during the dry season. She does not have a silo available.

   Ange calls you and asks you the following questions:

   a. Which method should I use to conserve the fodder?

   b. What tools and materials do I need?

   c. What steps do I take?

   d. How do I know if it is high quality?

2. Discuss and write your advice to Ange on a piece of paper. You must address every question. Be sure to refer to **1.2 Key Facts** for guidance.

3. After you have completed the task, come together and present your advice to Ange. Listen and give the other groups feedback.

4. Verify your answers with the trainer.

Application Activity

Topic 1.2 Task 4:

1. Visit a local ruminant farm and greet the farmer.

2. Observe as the farmer or other staff demonstrate how to harvest fodder crops. Note what you see in the chart below:

Fodder Crop	Tools/Materials Used	Method of Harvesting

3. Then, take a tour of the farm to observe the fodder conservation practices. Ask the farmer the following questions about fodder conservation:

Questions	Answers
Do use conserve your fodder? Which method do you use (hay or silage production)?	
Why do you conserve your fodder?	
What materials and tools do you use?	
What are the challenges of conserving fodder?	
What advice do you have for ruminant farmers who want to conserve their fodder crops?	

4. If possible, assist with farmer with one of the fodder conservation methods. Refer to **1.2 Key Facts** to confirm that the hay and/or silage is high quality.

5. After the visit, discuss as a class:
- **a.** What did you learn?
- **b.** What surprised you?
- **c.** What are the challenges of fodder harvesting and conservation?

Points to Remember

- Timing of harvest must be considered according to the fodder species.
- Consider the fodder's water content during the conservation process.
- Large thunderstorms prevent hay from being properly preserved; it must then be stored in bulk and pressed under a shed. But if it is harvested too wet, it will produce fermentations which will warm the mass and will make low quality hay.
- Silage is created through anaerobic lactic fermentation.
- Silage-making has toxicity risks when certain precautions are not taken.

Formative Assessment

After carefully reading the following items, answer the following questions individually:

1. List the characteristics of high-quality hay and silage:

Hay	**Silage**
1.	1.
2.	2.
3.	

2. Explain the difference between the hay- and silage-making processes.

3. Complete the following sentences:

a. When making silage, you should sprinkle the chopped materials with a ……. and …… mixture.

b. …….. is an often forgotten step when making silage.

c. Silage should be left in the silo for a few …… before using it.

d. Mix …….. and …… for better quality hay.

Topic 1.3: Pasture maintenance

Key Competencies:

Knowledge	Skills	Attitudes
1. Explain how to perform pasture renewal practices	**1.** Renew pastures through various methods	**1.** Responsibility
2. Describe the importance of paddocking/rotational grazing	**2.** Apply pasture rotation/paddocking technique	**2.** Detail-oriented
3. Describe how to maintain pasture infrastructures	**3.** Maintain pasture infrastructures	**3.** Innovative

Getting Started: What do we know and where are we going?

Topic 1.3 Task 1:

1. Divide into small groups.

2. Discuss what you know about pasture grazing:
   a. From your own experience, describe how animals graze in your community.

   b. Are they fenced in? Or are they free to graze anywhere?

   c. What happens when the grass in the pasture becomes dry or eaten?

3. After you have discussed, come together and share your ideas with the class.

4. Review the Key Competencies table, which includes the knowledge, skills, and attitudes you will gain by the end of this topic.

Problem Solving Activity

Topic 1.3 Task 2:

1. With your group from the first activity, consider the following methods for pasture renewal:
   a. Weeding
   b. Replacing grasses
   c. Applying fertilisers
   d. Over-sowing

2. For each method, brainstorm a definition, one advantage, and one disadvantage of each method using your previous knowledge and experience. One person in each group should write your group's ideas down.

3. After you have discussed, share your ideas. Volunteer to record these ideas on the board/flipchart for the class to observe.

4. Now, read through **1.3 Key Facts** as a class. Volunteer to read a section.

5. After reading all of **1.3 Key Facts**, revise your responses to **Question 1** by adding or removing information from each pasture renewal method.

6. Finally, participate in a class discussion about paddocking/rotational grazing:
   a. Have you ever witnessed paddocking/rotational grazing in your communities?

   b. What are the benefits?

   c. What are the challenges?

1.3 Key Facts

- **Pastures:**
  - Any plant community in which forage–grasses, legumes, herbs and trees–form the dominant vegetation which ruminants eat for food
  - Rwanda has six dominant types of natural grasslands, which are determined by the amount of rainfall and soil fertility.
  - Management of natural pastures is an integral system involving management of the plants and soil on one hand and herd management the other hand.

- **Natural:** Has developed naturally; is native or hard; vegetation consists of wild perennial herbs, lichens (tundra), subshrubs, and shrubs
- **Artificial**: Non-native or soft and tend to have a much higher forage biomass which makes them ideal for grazing; contain grasses that are more vigorous, competitive in a controlled system over a nomadic pastoral system typical of natural pastures
- **Pasture establishment steps:** Perimeter fencing, paddocking, establishment of watering points/troughs, land preparation, planting fodder

- **Pasture renewal:**
  - **Weeding**
    - Weeds reduce grass productivity, and some are poisonous.
    - Tools: hoes and machetes
    - Uproot and slash weeds before they shed seeds.
  - **Replacing grasses**
    - Only replace 25% of field area each year because livestock need places to graze.
    - New grasses may not grow as expected.
    - Keep livestock away from newly planted area until grasses are ready for consumption.
    - Determine readiness when you are able to pull grasses up with your hand.
  - **Applying fertilisers**
    - Spray fertilizers according to the inputs needed for soil.
    - Consider nitrogen, phosphorous, and potassium levels.
    - Do a soil test to determine nutrient requirements.
    - Can be harmful to the environment if applied incorrectly
  - **Over-sowing**
    - Integration of improved grasses or legumes to a natural pasture.
    - Use when soils are poor, light, and/or loose and/or when pastures lack high quality legume content.
    - Method: Overgraze natural pasture; harrow/hoe the land; broadcast legume or grass seeds.[4]

- **Rotational/paddock grazing:**
  - Pasture area is divided into two or more sub pastures, also called “paddocks,” with each sub pasture being grazed and “rested” in turn.
  - Rotate livestock between paddocks as needed
  - Paddocks should be divided into square shapes if possible
    - Reduces length of fence needed

[4] Snohomish Conservation District. (2016, March 22). *The how and when of pasture renovation*. https://snohomishcd.org/blog/2016/3/22/xxwep7sr64iijnmie89veam3c9y6it

    - Uniform grazing distribution
  - Better management of forage and fodder within the pasture
  - Requires more labour
  - Tools and materials: fencing, water sources

- **Infrastructure maintenance:**
  - **Water pipes and drinkers**: Keep livestock within 250 metres of water to increase water consumption, improve grazing distribution, and distribute manure more uniformly.
  - **Pathways/lanes**: When rotating, move livestock through pathways instead of across other paddocks.
  - **Shading trees:** Keep grasses cooler and higher quality, whereas sun dries out grasses.
  - **Infrastructure facilities:** Use water and fencing to control livestock movement and flooding.[5]

Guided Practice Activity

Topic 1.3 Task 3:

1. In your small group, read and record your responses to the following scenario and questions:

After researching the benefits of paddocking, Jean de Dieu decides to implement this grazing system on his ruminant farm. Before getting started, Jean de Dieu asks your advice on the following items:

a. How should the paddocks be divided?

b. What tools and materials will he need?

c. Once he has established his grazing system, how can he maintain the infrastructure to ensure productive and effective grazing?

2. After all the groups have completed the task, ask someone from your group to present your advice to Jean de Dieu. Listen closely and give feedback to the other groups while

[5] Afrane Okese, K. (2018, February 19). *Paddock grazing system: A solution to cattle production in Africa*. Agrihome. https://blog.agrihomegh.com/paddock-grazing-system/

they present.

3. After all the groups have presented, verify the correct answers using **1.3 Key Facts** and information from the trainer.

Application Activity

Topic 1.3 Task 4:

1. Visit a ruminant farm and greet the farmer and any other staff present.

2. First, interview the farmer about the different pasture renewal processes he or she uses. Use the chart below to guide you and as a place to record the information.

Pasture Renewal Method	Uses? (Yes or No)	Benefits	Challenges
Weeding			
Replacing grasses			
Applying fertilisers			
Over-sowing			

3. Then, take a tour of the farm with the farmer. Observe the ruminants as they graze. Discuss as a class using the following questions:
   a. What do you notice about the grass or other fodder crops? What colour are they?

   b. Are there shading trees? Are there pathways/lanes for the animals to move through?

   c. Where is the water source located?

   d. Is the grazing uniformly distributed? Why or why not?

4. Be sure to ask the farmer any additional questions you have about pasture maintenance.

Points to Remember

- Graze animals when grass is at the early flowering stage by moving animals from paddock to paddock.

- Four essential steps to be followed for establishing improved pastures:
  1. Perimeter fencing
  2. Paddocking
  3. Establishment of watering points/troughs
  4. Planting fodder

- The productivity of a pasture is biomass formed during a specific time (usually one year), on a given area.

Formative Assessment

After carefully reading the following items, answer the following questions individually:

1. Explain one advantage and one disadvantage of rotational/paddock grazing:
Advantage:

Disadvantage:

2. Explain the difference between natural and artificial pastures.

3. Identify each statement as either **true** or **false**:
a. Over-sowing reduces grass productivity.

b. You should only replace 50% of field area with new grasses per year.

c. It is advisable to do a soil test before selecting and applying a fertiliser.

Self-Reflection

1. You have come to the end of the unit. You are going to do the survey you did at the beginning of the unit again to help you do self-assessment of your knowledge, skills, and attitudes.

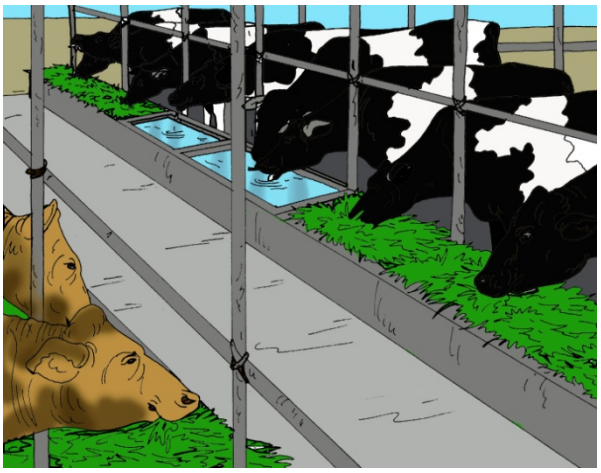
Again, there are no right or wrong answers to this survey. It is for your own use to gauge your knowledge, skills and attitudes after the unit. Read the Knowledge, Skill or Attitude in the left column. Think about yourself: do you think you can do this? How well? Read the statements across the top. Put a check in column that best represents your situation.

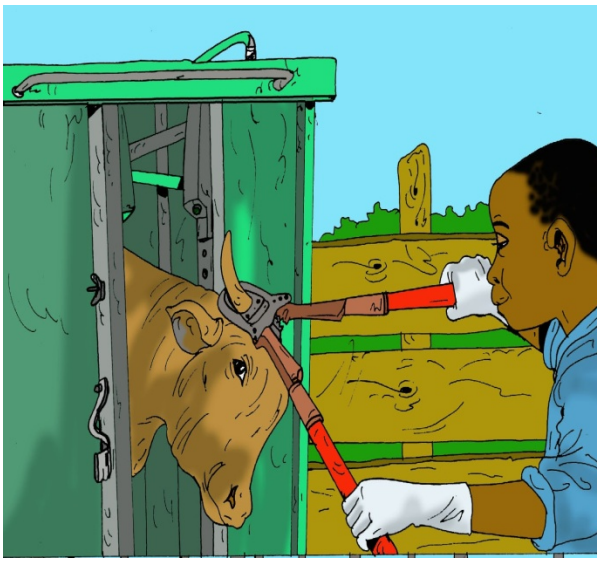
My experience **Knowledge, skills, and attitudes**	**I don't have any experience doing this.**	**I know a little about this.**	**I have some experience doing this.**	**I have a lot of experience with this.**	**I am confident in my ability to do this.**
Classify forage					
Describe fodder crops					
Prepare land for fodder crops					
Plant fodder crops					
Describe how and when to harvest fodder crops					
Make hay					
Make silage					
Renew pasture					
Establish paddocks and apply rotation in pastures					
Maintain infrastructures of pasture					

2. Complete the table below by identifying areas from the unit where you have improved and where you need improvement with the actions/strategies you will use to help you improve when receiving and interpreting information at the workplace.

Areas of strength	Areas for improvement	Actions to be taken to improve
1.	**1.**	**1.**
2.	**2.**	**2.**

Unit 2: Ruminant management practices





Topics

2.1 Installation of ruminant in shelter

2.2 Feeding and watering the ruminant

2.3 Minor surgery

Unit Summary:

This unit equips trainees with knowledge, skills, and attitudes to perform ruminant management practices. At the end of this unit, trainees will be able to install ruminants in shelters, feed and water ruminants, and perform minor surgeries with close supervision.

Self-Assessment: Unit 2

1. Look at the illustration. What is happening? What do you think this unit will be about? What topics might be covered?

2. Fill in the self-assessment below.

There are no right or wrong ways to answer this survey. It is for your own use during this course. The trainer will read a skill that is listed in the left column. Think about yourself: do you think you can do this? How well? Read the statements across the top. Put a check in column that best represents your situation. At the end of this unit, we'll take this survey again.

My experience **Knowledge, skills, and attitudes**	**I don't have any experience doing this.**	**I know a little about this.**	**I have some experience doing this.**	**I have a lot of experience with this.**	**I am confident in my ability to do this.**
Identify cleaning products used in ruminant shelters					
Identify equipment for ruminant shelters					
Perform cleaning and disinfection of ruminant shelters					
Install equipment in ruminant shelters					
Separate ruminants into different boxes					
Identify ruminant feeds					
Plan feeding and watering schedule					
Weigh and distribute feeds					
Identify surgical materials					
Apply disinfection and sterilization of surgical materials					

My experience Knowledge, skills, and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
Apply restraining techniques					
Perform castration procedure					
Perform dehorning procedure					
Perform hoof trimming procedure					
Perform tail docking procedure					

Topic 2.1: Installation of ruminants in shelters

Key Competencies:

Knowledge	Skills	Attitudes
1. Identify cleaning products	**1.** Clean ruminant shelters	**1.** Detail-oriented
2. Identify disinfectants and their role in the cleaning process	**2.** Disinfect ruminant shelters	**2.** Proactive
3. Identify the characteristics of ruminant boxes	**3.** Separate ruminants into boxes	**3.** Methodical

Getting Started: What do we know and where are we going?

Topic 2.1 Task 1:

1. Separate into small groups (2-3 people) and choose the secretary for each group. Discuss ruminant shelters using the following questions:
   a. What does a ruminant shelter look like?

   b. How are ruminants organised within the shelter? Do all ruminants live in the same box or stall area?

   c. How should ruminant shelters be maintained to keep animals healthy?

2. After discussing, share your answers and ideas. Explain your reasoning, using previous knowledge or experiences.

3. Review the Key Competencies table, including the knowledge, skills, and attitudes you will gain by the end of this topic.

Problem Solving Activity

Topic 2.1 Task 2:

1. Consider the following situations with a partner. They should discuss the potential effects of the situation and what actions they would take:
   a. There is dirt covering the walls of cattle box/area and several centimetres of mud inside.

   b. The temperature in the sheep shelter is 22°C.

   c. There is very little wind and excess manure in the animal shelter.

2. After you have discussed, share your ideas while the trainer writes them on the board/flipchart for everyone to see. Apply any previous knowledge you have about climactic factors to the situations. The answers will be revealed in **2.1 Key Facts**.

3. Now, individually and silently read through **2.1 Key Facts.** As you read, you should:
   - ✓ Check or tick the information that applies to the situations in **Question 1**.
   - ❖ Star any information that is interesting or surprising to you.
   - ○ Circle any information that is confusing or unclear to you.

4. After all the trainees have read and marked **2.1 Key Facts,** listen carefully as the trainer clarifies the answers to **Question 1.**

5. Then, share what you found surprising/interesting and what you found confusing. The trainer will clarify any misunderstandings and confusion.

2.1 Key Facts

- **Cleaning the ruminant shelter:**
  - To remove unwanted material, such as dirt or other matter, from a surface.
  - A clean shelter protects animals from diseases.
  - Must be performed correctly to be effective.

- **Cleaning products:**
  - **Soap/detergent**: Cleaning agent which works by suspending dirt and grease. Does not kill harmful microorganisms.
  - **Disinfectant:** Chemical agent which kills harmful microorganisms. Does not necessarily remove dirt or grease.
  - **Degreaser**: More powerful soap/detergent specially formulated to penetrate layers of dried on body oils and other greasy debris.

- **Most important areas for cleaning:**
  - **Pre-vaccination surfaces**: Animals must have contact with especially clean surfaces when first admitted and have no protection from vaccination.
  - **Animal housing between occupants:** Especially sick animal areas.
  - **High contact surfaces**: Hallways, doorknobs, sitting areas.
  - **Yourself:** People move around shelters much more than animals do. Must keep our hands, arms, clothing and feet clean (either by cleaning or by use of protective garments) to prevent disease spread.[6]

- **Cleaning stages:**
  1. **Pre-cleaning**: Remove loose dirty and food waste by pre-rinsing.
  2. **Main Cleaning:** Wash without water and detergent.
  3. **Rinse:** Remove loose food waste, grease and detergent.
  4. **Disinfection:** Kill bacteria with disinfectants or heat.
  5. **Final rinse:** Remove the disinfectants.

[6] Ontario SPCA and Humane Society. (n.d.). *Cleaning*. https://ontariospca.ca/spca-professional/shelter-health-pro/infection-disease-control/cleaning-disinfection/cleaning/

6. **Drying**: Remove all moisture.[7]

- **Disinfecting the ruminant shelter:**
  - To cleaning something with a chemical (disinfectant) to destroy bacteria.
  - Some disinfectants: Ammonia solution, Sodium Hypochlorite. Sodium Hydroxide, Phenols, Chloramines, Quaternary ammoniums, Chlorhexidine.

- **Selecting a disinfectant:**
  - Must be used at the correct concentration.
  - Require adequate contact time with dirty surfaces.
  - Must be applied to a basically clean, non-porous surface, free of organic matter.
  - Disinfectants and detergents can cancel each other's actions and should not be mixed unless specifically directed by the manufacturer.

- **Ruminant shelter considerations:**
  - **Temperature**:
    - Ideal range is 10-20 C
    - Reduced activity in hot environment
    - Cluster together in low temperatures
  - **Humidity**:
    - Ideal range is 40-80% relative humidity
    - More difficult to absorb animal sweat in hot humid climates
    - Animals struggle to cool themselves
  - **Radiation**:
    - Direct sunlight and sunlight reflected from clouds
    - Can irritate animals and their skin
    - Reduced with provision of shaded areas
  - **Air movement:**
    - Ideal range is 0.2-1.0 m/s
    - Assist in body heat loss in high temperatures
    - Leads to excessive cooling in low temperatures
    - Help remove toxic gases from shelter
  - **Precipitation:**
    - Also known as rain
    - Can lead to excessive cooling
    - Prevented with provision of shelters[8]

[7] User: Alpha WebAPPt. (2019, April 1). *Cleaning and disinfection generally consists of six steps*. Hygiene Plus. https://hygieneplusuae.com/2019/04/01/cleaning-and-disinfection-generally-consists-of-six-steps/

[8] Food and Agriculture Organization of the United Nations (FAO), & Information Network on Post-Harvest Operations (INPhO). (1998). *Farm structures in tropical climates: Animal environmental requirements*. https://www.fao.org/3/s1250e/S1250E10.htm#Animal%20environmental%20requirements

- **Cattle boxes:**
  - Proper living conditions promote milk production and reproduction
  - Avoid extreme heat (25-30 °C) and direct sunlight
  - Remove/prevent mud and manure from entering the area because they can cause infections
  - Concrete floors are ideal
  - Provide overhead shade of 2.5 to 3 metres per animal
  - Establish roof at least 3 metres high for more air movement[9]

- **Sheep and goat boxes:**
  - Minimum housing needed
  - Simple thatched shelter to provide shade and protect from rain
  - Minimise mud; build on well-drained or sloped ground
  - Protection from wind

- **Maternity boxes**
  - Provide separate shelter.
  - Monitor twice per day.
  - Should be clean, well-ventilated, with bedding (sand or grit).
  - Allow some freedom to move around in the field but keep close to shelter—not grazing too far—at the end of pregnancy.[10]

Guided Practice Activity

Topic 2.1 Task 3:

1. Tell trainees to turn to **Topic 2.1 Task 3** in their manuals and consider the following scenario with their groups from **Task 1**:

Marie Claire has just purchased a small ruminant farm from her neighbour. The farm currently houses several cattle, but she wants to add her own goats as well. She plans to make some renovations on the animal shelters. Please advise her on the following points:

[9] Food and Agriculture Organization of the United Nations (FAO), & Information Network on Post-Harvest Operations (INPhO). (1998). *Farm structures in tropical climates: Cattle housing*. https://www.fao.org/3/s1250e/S1250E11.htm

[10] Food and Agriculture Organization of the United Nations, & Information Network on Post-Harvest Operations (INPhO). (1998). *Farm structures in tropical climates: Sheep and goat housing*. https://www.fao.org/3/s1250e/S1250E17.htm#Sheep%20and%20goat%20housing

a. What steps should she take to clean the shelter?

b. What products or materials will she need to clean and disinfect?

c. What climactic factors should she consider when renovating the shelter?

d. How should she house the cattle and sheep?

2. Present your group's advice to Marie Claire to the rest of the class. Be sure to listen and provide feedback at the end of each presentation.

3. After all the groups have presented and given each other feedback, verify the correct answers with the trainer.

Application Activity

Topic 2.1 Task 4:

1. Visit a local ruminant farm and greet the farmer and any other workers present.

2. Take a tour of the ruminant shelters and note what you see in the chart below.

Type of Ruminant	Shaded Areas	Temperature/Heat	Mud/Dirt

3. After touring and taking notes, ask the farmer any questions you have about ruminant shelters. Remember that this is the time to get information from a professional in the field.

4. After the visit, discuss as a class:
   a. What did you learn?
   b. What surprised you?

Points to Remember

- Be aware of the chemicals in disinfectants and be sure to dispose of them safely.
- Always read the manufacturer's instructions on disinfectants and detergents.
- Cleaning schedules are always needed and useful.
- Monitor and record the status of ruminant shelters to ensure they are maintained properly.

Formative Assessment

After carefully reading the following items, answer the following questions individually:

1. Explain the difference between cleaning and disinfection.

2. List two of the most important areas for cleaning.
   1.
   2.

3. Identify each statement as either **true** or **false**:
   a. Mud is not a problem for cattle shelters as long as it is all in one corner of the box.

   b. Air movement can lead to excessive cooling in low temperatures.

   c. Pregnant ruminants do not need to be kept in a separate area when they are close to giving birth.

   d. Radiation is caused by direct sunlight and sunlight reflected from clouds.

Topic 2.2: Feeding and watering of the ruminants

Key Competencies:

Knowledge	Skills	Attitudes
1. Identify different types of ruminant feeds	**1.** Differentiate between types of feed based on ruminants' needs	**1.** Precision
2. Explain measuring and rationing feeds	**2.** Distribute feed and water to ruminants	**2.** Detail-oriented
3. Describe the importance of cleaning feeders and drinkers	**3.** Clean drinkers and feeders	**3.** Responsibility

Getting Started: What do we know and where are we going?

Topic 2.2 Task 1:

1. Discuss the following questions with a partner based on your previous knowledge and experiences:

a. What do ruminants eat?

b. What do ruminants drink?

c. What is the importance of feed and water for ruminants? How do they affect animal health?

2. Share your ideas with the rest of the class. Compare and contrast your answers with the others:

a. Do you agree with each other?

b. Do you disagree?

c. Why or why not?

d. Explain your reasoning based on specific knowledge and experiences.

3. Review the Key Competencies table, including the knowledge, skills, and attitudes you will gain by the end of this topic.

Problem Solving Activity

Topic 2.2 Task 2:

1. Consider the following information and discuss the questions with your partner from **Task 1**:

   Ruminants need the right amounts of protein, minerals, and nutrients to be productive and healthy.

   a. Do you think forage and fodder provide enough protein, minerals, and nutrients for ruminants? Why or why not?

   b. What could you do to increase the amount of protein, minerals, and nutrients in a ruminant's diet?

   c. What preventative actions could you take to ensure animals don't consume dirty or spoiled food and water?

2. After discussing, share and debate your ideas as a class.

3. After the class discussion, refer to **2.2 Key Facts.** Read each section out loud as a class. As you read, do the following:
   - ❖ Star the ways to increase the amount of protein, minerals, and nutrients in a ruminant's diet (**part b**).
   - ○ Circle the preventative actions that could be taken to ensure animals don't consume dirty or spoiled food and water (**part c**).

4. After reading, share which information you starred and circled. Refer back to your responses to **Question 1** and clarify any misunderstandings with the trainer.

2.2 Key Facts

- **Types of feeds:**
  - **Forage**
    - Feeds of plant origin
    - Include: fodder, silage, hay, pastures
  - **Supplementary**
    - Provides additional nutrients/minerals to animals and/or increases their feed intake.
    - Address diet deficiencies in protein, minerals, and vitamins

- **Types of supplementary feeds:**
  - **Concentrated feed**
    - Commercially prepared feeds usually rich in food value and energy.
    - Made of grains and grain by-product, blood, bones, cotton and groundnut seed residues, and sugar refineries, like molasses.
    - Low-fibre and high protein
  - **Mineral block**
    - Molasses-urea solidified mixtures improve ruminant diets and production
    - Molasses contains various minerals and is appealing to animals
    - Urea provides fermentable nitrogen and increases animals' intake of other foods[11]

- **Measuring feeds:**
  - **Grasses/Cereals**
    - Low digestibility, which reduces animals' appetites
    - Leads to decreased production
    - Can eat a lot, but takes a lot of energy to digest it
  - **Legumes**
    - Higher digestibility than grasses/cereals
    - Small amounts of high-quality legumes can increase feed value[12]
  - **Food formulation/ration**
    - Feed should contain a combination of the following:
      - Energy: Carbohydrates and fats to maintain the body and produce.
      - Protein: For growth and production.
      - Minerals: For growth and reproduction.
      - Vitamins: To regulate biological processes and as a source of nutrients.

[11] Jayasuriya, M. C. (n.d.). *Principles of ration formulation for ruminants*. International Atomic Energy Agency. https://inis.iaea.org/collection/NCLCollectionStore/_Public/33/032/33032967.pdf?r=1&r=1

[12] Food and Agriculture Organization of the United Nations. (n.d.). *Feed quality*. https://www.fao.org/ag/againfo/themes/documents/PUB6/P618.htm

- Water: For growth, heat regulation, biological processes, and production.[13]

- **Cleaning:**
  - **Feeders**
    - Change feed often to promote animal health and prevent disease.
    - Remove old feed every day and replace with fresh feed and concentrate.
    - Feed may become spoiled, sour, or mixed with faeces if not changed often.
  - **Drinkers**
    - Must be cleaned regularly to ensure animals have access to fresh, clean water at all times.
    - Blue or green algae release toxins into the water.
    - Process: Remove old water, spray drinker with hose to remove dirt and algae, scrub with soap and brush.
    - Keep drinkers away from feeders.[14]

- **Feed distribution general guidance**
  - **By age**
    - Newborn animals first drink from their mother's milk (colostrum)
  - **By physiological status**
    - **Dairy cattle**: A concentrate mixture made up of protein supplements, energy sources, tapioca chips, and laxative feeds such as brans; mineral mixture at a level of 2%
    - **Bulls**: Good quality roughage with sufficient concentrates
    - **Sheep and goats**: If grazing pasture is good there is no need to supplement concentrate mixture; if poor grazing conditions, animals may be supplemented with concentrate mixture of 150 – 350 g of concentrate/animal/day depending up on the age, pregnancy, and lactation.
    - **Pregnant animals**: Pregnant animals should be allowed in good quality pasture 4-5 hours per day; ration must be supplemented with green fodder at 5 kg per head per day.[15]

- **Water distribution**
  - Water is an essential nutrient to life.
  - Water needs to be fresh, clean, and plentiful to ensure maximum intake.
  - Water should be available at all times.

[13] Infonet Biovision. (2019, October 2). *Animal nutrition and feed rations*. https://www.infonet-biovision.org/AnimalHealth/Animal-nutrition-and-feed-rations

[14] Kelley, A. (2016, June 2). *The best way to clean water troughs*. Hobby Farms. https://www.hobbyfarms.com/the-best-way-to-clean-water-troughs/

[15] Vikaspedia. (n.d.). *Feeding management*. https://vikaspedia.in/agriculture/livestock/sheep-and-goat-farming/feeding-management

- Water requirements increase during extreme temperatures (high or low).

Guided Practice Activity

Topic 2.2 Task 3:

1. Separate into small groups (3-4 people) and read the following scenario:

You have been hired to establish a feeding plan at a local ruminant farm. The farmer informs you that the ruminants are eating a lot of grasses/cereals and no legumes. They are able to access water in the mornings and evenings. The cleaners and drinker are refreshed once per week and cleaned once per month. All of the different animals are given the same amount of food.

2. With your group, write a plan/report that addresses the following:

a. What are the problems with the current feeding plan?

b. What suggestions can you offer to the farmer?

c. Explain the importance of each suggestion.

3. After all groups have finished, exchange your report with another group. Give written feedback with explanations to the other group.

4. Then, return the report to the original group and volunteer to share your suggestions for the farmer. Discuss if there is disagreement about the correct answers.

5. Finally, verify the correct answers with the trainer.

Application Activity

Topic 2.2 Task 4:

1. Visit a local ruminant farm and greet the farmer and other staff.

2. First, closely observe the farmer as he/she demonstrates how to weigh and distribute feed to the animals. Note the tools and materials used below:

Tools	Materials

3. Then, ask the farmer how much feed is distributed to different types of animals and note his/her responses in the chart below:

Type of Ruminant	Age	Pregnant?	Amount of Feed Given

4. If possible, assist the farmer with feed distribution in small groups.

5. Finally, ask the farmer what the challenges are with feed and water distribution in his/her experiences. Note the response.

Points to Remember

- Concentrate must be fed individually according to production requirements.
- Over-feeding concentrates may result in off feed and indigestion.
- Abrupt changes in the feeding schedule should be avoided.
- Grains should be ground to medium degree of fineness before being fed to cattle.
- Long and thick-stemmed fodders such as Napier may be chopped and fed.

- Highly moist and tender grasses may be wilted or mixed with straw before feeding.
- Legumes may be mixed with straw or other grasses to prevent the occurrence of bloat and indigestion.

Formative Assessment

After carefully reading the following items, answer the following questions individually:

1. Explain the importance of cleaning feeders and drinkers regularly.

2. List three of the components that should be combined in feed rations and their purposes:
1.
2.
3.

3. Select the correct answer.
Which type of animal requires no supplement concentrate if the grazing pasture is good?
a. Dairy cattle
b. Bulls
c. Sheep and goats
d. Pregnant animals

4. Select the correct answer.
Which type of animal's ration should be supplemented with green fodder each day?
a. Dairy cattle
b. Bulls
c. Sheep and goats
d. Pregnant animals

5. Explain the benefits of mineral blocks.

Topic 2.3: Minor surgery

Key Competencies:

Knowledge	Skills	Attitudes
1. Identify materials used in minor surgery	**1.** Select, manipulate, and maintain surgical materials	**1.** Precision
2. Describe restraining techniques	**2.** Restrain ruminants	**2.** Diligent
3. Describe castration, dehorning, trimming, and tail docking techniques	**3.** Perform minor surgical operations on ruminants	**3.** Detail-oriented

Getting Started: What do we know and where are we going?

Topic 2.3 Task 1:

1. With a partner, brainstorm responses to the following questions:
   a. What are the different surgery operations that are performed on ruminants?

   b. Why do you think a ruminant might need surgery?

2. After discussing, ask volunteers to share their ideas with the rest of the class.

3. Introduce the learning outcome and the Key Competencies table, which includes the knowledge, skills, and attitudes they will gain by the end of this topic.

Problem Solving Activity

Topic 2.3 Task 2:

1. There are four common types of minor surgeries for ruminants:
   a. Castration (removal of testicles)
   b. Dehorning (removal of horns)
   c. Caudectomy (removal of tail)
   d. Hoof trimming

2. Separate trainees into small groups (3-4 people). For each type of surgery, tell the groups to brainstorm three or more possible causes and/or purposes for performing these surgeries.

3. After brainstorming the causes of each type of surgery, tell the groups to discuss how they could restrain, or hold, the animals while performing surgeries.

4. Next, ask groups to share some of their answers and write them on the board/flipchart for everyone to observe.

5. To confirm the correct answers, direct trainees to **2.3 Key Facts.** Read the information out loud as a class.

6. After reading **2.3 Key Facts** as a class, tell the trainees to read the information again with their groups. This time, they should do the following while they read:
   - _ Underline the definitions for each type of surgery.
   - ✓ Check or tick the reasons and causes they guessed correctly from **Question 2**.
   - ❖ Star the reasons and causes they did not guess correctly from **Question 2.**
   - o Circle any materials needed for the different types of surgeries.

2.3 Key Facts

- **Dehorning:** Process of removing or arresting the growth of the horn by destroying the root of the horn bud; for economic or safety reasons.
  - **Purposes:**
    - To prevent injuries to other animals and accidents
    - To treat horn damage or diseases
    - To promote safety of farm workers
    - To facilitate handling of animals
    - To improve appearance
    - To maximise space in transportation vehicles

- **Castration:** A routine practice on a livestock farm which consists of neutering male animals by removing the testicles; recommended that bull calves not needed for breeding be castrated sometime between 4-10 weeks of age.
  - **Purposes:**
    - To remove injured, cancerous, or retained testicles
    - To treat prostate disease or tumours
    - To increase growth rate
    - To improve quality of meat

- To prevent aggressive behaviour
- To prevent unwanted mating
- To maintain a certain male to female ratio

- **Caudectomy (tail docking):** Common practice to remove the tails or part of the tail from lambs; carried out at 1-3 months of age.
  - **Purposes:**
    - To reduce uncontrollable urinating and faecating
    - To improve parasite control
    - To improve cleanliness of wool
    - To reduce faecal contamination
    - To reduce tail injuries
    - To reduce mastitis

- **Hoof trimming:** Common surgical operation to remedy many hoof conditions, either infectious or non-infectious.
  - **Causes:**
    - Overgrowth
    - Foreign body
    - Laminitis (inflammation of the laminae of the hoof/foot)
    - Digital dermatitis
    - Foot Rot
    - Interdigital Dermatitis

- **Restraining techniques:**
  - **Physical**
    - Requires two people
    - One person to hold the animal while the other one performs surgery.
    - If you walk behind an animal, make your presence known or it may become stressed and start kicking
  - **Crush**
    - Also known as a chute
    - Strong stall to hold/restrain cattle in
    - Minimises injury
    - Direct cattle into open crush and close door behind it
    - Squeeze crush to calm the animal and keep it in place for surgeries
  - **Tools**
    - Table
    - Rope + Fence

- Tail jack[16]

- **Castration techniques:**
  - **Blood**
    - Remove using sterilised blade/knife; disinfect scrotum and apply anaesthesia to animal in advance; stitch and disinfect wound after
  - **Non-blood**
    - Burdizzo (pincer) method: Crush the blood vessels for at least 10 seconds, interrupts the blood supply to the testicle and thus kills the testicle.
    - Elastrator method: Band the scrotum until it falls off.

- **Dehorning techniques:**
  - **Disbudding/hot iron method:** An iron metal is put in fire and then passed over growing buds of the horns until they are burned off; quick, cheap and no bleeding occurs because the hot iron seals off the blood vessels; apply antibiotic powder or ointment after.
  - **Saw/wire saw method for adults:** Give animal anaesthesia, mark around the horns, then cut off horns using a saw/wire saw

- **Hoof trimming techniques:**
  - Using a sharp knife to cut off small pieces of hoof.
  - Edges of the hoof need cutting most.
  - Do not cut too deep, especially over the soft middle part of the hoof.
  - If the foot bleeds, stop cutting and apply disinfectant.
  - If the foot smells or is hot and painful, it is probably infected or has an abscess.

- **Caudectomy techniques:**
  - **Cauterisation/hot iron:** Iron cuts and cauterizes the tail simultaneously.
  - **Cutting and crushing method (emasculator):** An emasculator has both a cutting and crushing mechanism. The crushing mechanism seals the blood vessels on the tail remaining on the lamb, while the cutting edge effectively removes the tail. The emasculator should be left on the tail for approximately 30 seconds to prevent bleeding.
  - **Sharp excision (scalpel or knife blade):** A scalpel or very sharp knife which is not used for any other purpose must be employed. It should be placed in an antiseptic liquid after use on each lamb. Good hygiene is essential.
  - **Burdizzo:** A Burdizzo or similar bloodless castration instrument is used to crush the tail, preferably on a joint. A Burdizzo is similar to an emasculator except it does not

[16] AnimalHandling101. (n.d.). *Restrain cattle*. Retrieved 2019, from https://animalhandling101.fandom.com/wiki/Restrain_cattle

have a cutting mechanism. It is held in place for 5 or 6 seconds and then a knife is used to cut off the tail below the crush.

- **Rubber ring method (bloodless):** Most widely used method. Use an elastrator to apply a constricting latex ring to the tail below the level of the anus in males and the vulva in females. The ring cuts off blood supply to the tail, causing it to shrivel and fall off 10-14 days later. Use rubber rings when lambs are 1-7 days old, and the tail should drop off 10-14 days later.[17]

Guided Practice Activity

Topic 2.3 Task 3:

1. First, watch four videos depicting the four common ruminant surgeries closely. Note the following for each procedure:
   a. Materials used

   b. Restraining techniques applied

   c. Challenges

2. Then, separate into four groups and each group will be assigned one of the four minor surgery operations: castration, dehorning, hoof trimming, or tail docking/caudectomy.

3. Your group's task is to write a manual for how to perform your assigned surgery. Refer to **2.3 and 2.4 Key Facts** as well as other resources, including the internet, reference books, the videos from earlier, and other professionals on campus. The manuals must include:
   a. The importance of the surgery.

   b. The causes/reasons for the surgery.

   c. How to restrain the animal for surgery.

   d. 2-3 techniques for surgery.

   e. Materials needed for surgery.

[17] Schoenian, S. (2019, October 12). *Docking and castrating*. Sheep 101. https://www.sheep101.info/201/dockcastrate.html

f. Sanitation measures.

4. Ask for guidance from the trainer as needed. Remember that each group will present its manual to the rest of the class.

5. After the manuals have been completed, take turns presenting your manuals. Be sure to cite your sources for any information included outside of **2.3 and 2.4 Key Facts**.

6. After all the groups have presented, listen to the trainer's feedback and ask any remaining questions that you have at this time.

2.4 Key Facts

- **Disinfection and sterilisation of surgical materials:**
  - Must kill all bacteria and viruses present before using materials on animals.
  - **Types of disinfectant**
    - Alcohol
    - Chlorine and chlorine compounds
    - Antiseptic
  - **Sterilisation techniques**
    - Steam/autoclave: Place materials in a pack and expose to steam under pressure
    - Gas: Apply ethylene oxide gas to materials
    - Note: Chemical disinfection is not the same as proper sterilisation[18]

Application Activity

Topic 2.3 Task 4:

1. Before visiting a local ruminant farm, work with your group from the previous activity to create interview questions for the farmer. Your group's questions should correspond to the minor surgery you were assigned previously. Write the questions into the chart below (sample question included):

[18] Penn State Animal Resource Program. (2015, July 14). *Instrument preparation and sterilization*. Penn State Research. https://www.research.psu.edu/arp/surgery/instrument-preparation-and-sterilization.html

Questions	Answers
Which technique do you use for castration?	

2. Visit a local ruminant farm and greet the farmer and any other staff present.

3. Take turns interviewing the farmer using the questions you created earlier. Note the answers in the chart.

4. Then, watch closely as the farmer demonstrates how to restrain and perform one of the minor surgeries on an animal.

5. If possible, assist the farmer with the minor surgery process in small groups.

6. After the visit, discuss as a class:

a. What did you learn?

b. What surprised you?

c. How was your experience similar to and/or different from the videos you watched during **Task 3**?

Points to Remember

- All operations must be done in aseptic conditions.
- All materials must be sterilized and disinfected.
- The operation area must be cleaned and disinfected between operations.
- Prevent post-operative complications of the wound.

- Monitor physiological status of the operated animals.
- Safely dispose of waste after operations as a biosecurity measure.
- Before operation, take the time to understand the anatomy of the animal to be operated on, especially the testicles, horns, hooves, and tails.

Formative Assessment

After carefully reading the following items, answer the following questions individually:

1. List three of the purposes of performing castration surgery.
   1.
   2.
   3.

2. Identify and explain the two techniques for dehorning animals.
   1.

   2.

3. Complete the following sentences:
   a. When performing a caudectomy, an ……. tool can be used to both cut and crush the tail.

   b. The …….. method or technique crushes the blood vessels to kill/remove the body part. It does not have the cutting feature.

   c. Heating a …… …… and pressing it to the horns of an animal is a quick and cheap way to remove the horns.

Self-Reflection

1. You have come to the end of the unit. You are going to do the survey you did at the beginning of the unit again to help you do self-assessment of your knowledge, skills, and attitudes.

Again, there are no right or wrong answers to this survey. It is for your own use to gauge your knowledge, skills and attitudes after the unit. Read the Knowledge, Skill or Attitude in the left column. Think about yourself: do you think you can do this? How well? Read the statements across the top. Put a check in column that best represents your situation.

My experience **Knowledge, skills, and attitudes**	**I don't have any experience doing this.**	**I know a little about this.**	**I have some experience doing this.**	**I have a lot of experience with this.**	**I am confident in my ability to do this.**
Identify cleaning products used in ruminant shelters					
Identify equipment for ruminant shelters					
Perform cleaning and disinfection of ruminant shelters					
Install equipment in ruminant shelters					
Separate ruminants into different boxes					
Identify ruminant feeds					
Plan feeding and watering schedule					
Weigh and distribute feeds					
Identify surgical materials					
Apply disinfection and sterilization of surgical materials					

My experience Knowledge, skills, and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
Apply restraining techniques					
Perform castration procedure					
Perform dehorning procedure					
Perform hoof trimming procedure					
Perform tail docking procedure					

2. Complete the table below by identifying areas from the unit where you have improved and where you need improvement with the actions/strategies you will use to help you improve when receiving and interpreting information at the workplace.

Areas of strength	Areas for improvement	Actions to be taken to improve
1. **2.**	**1.** **2.**	**1.** **2.**

Unit 3: Ruminant reproduction assistance

Topics

3.1 Breed selection

3.2 Heat detection

3.3 Artificial insemination and mating assistance

3.4 Monitoring pregnancy

3.5 Parturition assistance

3.6 Weaning

Unit Summary:

This unit equips trainees with the knowledge, skills, and attitudes to perform ruminant reproduction management practices. At the end of this unit, trainees will be able to select breeds, detect heat, assist artificial insemination and mating, assist with parturition, and perform weaning.

Self-Assessment: Unit 3

1. Look at the illustration. What is happening? What do you think this unit will be about? What topics might be covered?

2. Fill in the self-assessment below.

There are no right or wrong ways to answer this survey. It is for your own use during this course. The trainer will read a skill that is listed in the left column. Think about yourself: do you think you can do this? How well? Read the statements across the top. Put a check in column that best represents your situation. At the end of this unit, we'll take this survey again.

My experience **Knowledge, skills, and attitudes**	**I don't have any experience doing this.**	**I know a little about this.**	**I have some experience doing this.**	**I have a lot of experience with this.**	**I am confident in my ability to do this.**
Select ruminant breeds according to production purpose					
Check breed pedigree based on data record					
Assist in heat synchronisation					
Detect heat based on physical signs					
Keep records					
Restrain animals					
Assist with artificial insemination					
Assist with goat/sheep mating					
Assist with pregnancy diagnosis					
Observe calving and kidding signs					

My experience Knowledge, skills, and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
Prepare maternity areas					
Assist with parturition					
Care for calving and kidding females and newborns					
Identify newborns					
Determine weaning period					
Perform weaning					
Install weaned calves and kids in boxes					

Topic 3.1: Breed selection

Key Competencies:

Knowledge	Skills	Attitudes
1. Differentiate between cattle breeds for milk and for meat	**1.** Select milk and meat cattle breeds	**1.** Accurate
2. Differentiate between goat breeds for milk and for meat	**2.** Select milk and meat goat breeds	**2.** Precise
3. Differentiate between sheep breeds for wool and for meat	**3.** Select wool and meat sheep breeds	**3.** Detail-oriented

Getting Started: What do we know and where are we going?

Topic 3.1 Task 1:

1. Tell trainees to brainstorm answers to the following questions from **Topic 3.1 Task 1** in their manuals with a partner:
   a. What is the purpose of ruminant farming?

   b. What are the two main uses of cattle?

   c. What are the two main uses of sheep?

   d. What are the two main uses of goats?

2. After discussing, ask volunteers to share their ideas for each question. Write their answers on the board/flipchart for the class to see. Encourage trainees to discuss and debate each other's answers.

3. After most people have shared, explain that ruminant farming plays a significant role in sustainable agriculture. By eating pasture and fodder crops, ruminants are able to convert them into food for humans (their own meat). In addition to meat, ruminants produce milk and wool for economic gains.[19]

4. Introduce the learning outcome and the Key Competencies table with the knowledge, skills, and attitudes they will gain by the end of this topic.

Problem Solving Activity

Topic 3.1 Task 2:

1. Separate into small groups (3-4 people) and reflect on your own experiences and previous knowledge raising ruminants.

2. Using your own experiences and previous knowledge, brainstorm a list of qualities that characterise good cattle, goat, and sheep breeds. One person in each group should write the answers on a piece of paper.

[19] Oltjen, J. W., & Beckett, J. L. (1996, June). *Role of ruminant livestock in sustainable agricultural systems*. PubMed. https://pubmed.ncbi.nlm.nih.gov/8791215/

3. After brainstorming, the entire class must agree on a list of five qualities that apply to cattle, sheep, and goats. Take turns sharing one quality your group discussed. After sharing a certain quality, explain your reasoning. The other groups should then express either agreement or disagreement with the idea. Decide on a final agreed list of five qualities that the trainer will write on the board/flipchart.

4. Next, participate a class discussion:
   a. How can we measure each of these good qualities?

   b. How can we preserve these good qualities in animals?

5. Consider the concept of breeding: Animals inherit, or take on, the qualities of their parents. Selection is when we choose certain animals with superior qualities to mate in order to preserve and pass on good traits and eliminate bad ones.

6. Finally, refer to **3.1 Key Facts**. Read the information out loud as a class.
   a. Use the **breed selection** section to reinforce the information that was introduced in **Question 5**.

   b. Check or tick the qualities you correctly guessed from **Question 2**.

3.1 Key Facts

- **Breed selection:**
  - **Overview**: Inheritance is the ability of animals to pass on their characteristics to their offspring.
  - **Selection:** The process of allowing certain animals to be parents of future generation; aims to preserve the good traits in animal breeds and eliminate bad ones.
  - **Criteria:**
    - **Production:** Choose animal that can produce enough and for a long time in terms of milk or large amounts of beef.
    - **Adaptability:** Animal chosen should be able to adapt to environmental conditions without losing weight.
    - **Disease-resistant:** Animals which show resistance to common diseases should be selected.
    - **Docility:** In case of dairy breeds, choose those which have good temperament. This enables easy handling during milking, ploughing, etc.
  - **Methods**
    - **Mass selection:** Based on their external appearance and allow them to mate randomly.

- **Individual selection:** Based on performance of individual animals in a herd. Requires a high level of record keeping.
- **Pedigree selection:** Based on performance of the parents (ancestors). Requires well-kept records. Useful when the animal to assess is too young or the traits under investigation are sex-linked.
- **Offspring/progeny selection:** Performance testing. An animal is evaluated on the performance of its offspring after which it is selected or rejected. Common when selecting breeding bulls. Valuable when considering characteristics like milk production, which can't be seen in males.
- **Collateral relative selection:** Based on the performance of many animals that are closely related. It should be used for characteristics that are highly inherited and when there is a close interval between generations.

- **Cattle breed selection qualities:**
  - **Milk production**
    - Udder should be pliable, silky, sack-like, and non-pendulous, but firmly attached.
    - Good feet and strong legs lead to longevity of a dairy cow and facilitates it to be able to feed comfortably.
    - A deep, long body with wide, sprung ribs to provide ample space for the rumen and other digestive system organs.
    - A wedge shape, long neck, good width between fore legs, wide pin bones, broad muzzle, and strong straight backline.
    - Sharpness across shoulders and slight general leanness all over the body ending with a thin fine tail.
    - Not stocky or beefy as this shows poor feed conversion efficiency.
  - **Meat production**
    - Good foragers on poor pastures.
    - Short legged.
    - Breed regularly.
    - High ability to convert feeds.
    - Tolerance to high ambient temperature.
    - Resistant to diseases as compared to dairy breeds.
    - Deep chest and girth.
    - Grow fast and mature early.
    - The body conformation is blocky, square, or cylindrical.

- **Common cow breeds in Rwanda:**
  - Friesian
  - Jersey
  - Brown Swiss

- Sahiwal
- Simmental
- Ankole

- **Sheep breed selection qualities:**
  - **Wool production**
    - Fleece weight
    - Fibre diameter
    - Length of staple (cluster of fibres)
    - Grade/quality of fleece: fine or coarse
    - Fleece uniformity
    - Rate of wool production
    - Fleece colour and softness
  - **Meat production**
    - Adaptability to the production environment
    - Type of coat or wool
    - Level of reproduction
    - Timing and frequency of lambing
    - Level of care required[20]

- **Common sheep breeds in Rwanda:**
  - Local
  - Blanc de montagne

- **Goat breed selection:**
  - **Meat production**
    - Adaptability to environmental and production conditions
    - Reproduction rate
    - Growth rate
    - Carcass characteristics (distribution of muscles, ratio of lean to fat to bone)
  - **Milk production (does/females)**
    - Strong, level top line; withers should blend smoothly into the shoulder blades (no bumps or humps as you run your hand down her neck over her withers and shoulders).
    - Front legs should be wide apart, strong, and straight—not curved as you look at them from the side.
    - Rear legs should be set wide apart at the hocks.

[20] Shoenian, S. (2019, October 20). *Breed selection*. Sheep 101. https://www.sheep101.info/201/breedselection.htm and New Mexico State University. (n.d.). *Improving economically important traits*. College of Agricultural, Consumer and Environmental Sciences. https://aces.nmsu.edu/sheep/selection_breeding/improving.html

- Short, strong pasterns—not ones that are broken and weak.
- Strength to withstand the rigors of heavy milking and strenuous kid bearing for many years.[21]

- **Common goat breeds in Rwanda:**
  - Local
  - Saanen
  - Boer
  - Alpine

- **Breed pedigree:**
  - Record of animal's line of ancestors to track continuation of superior qualities

- **Breed health status:**
  - **Physical behaviour**
    - Maturity
    - Adaptability
    - Calm temperament
  - **Samples for analysis**
    - Most reliable: blood sample
    - Other samples: cheek swabs, hair roots, skin, placental tissue[22]

Guided Practice Activity

Topic 3.1 Task 3:

1. Direct trainees to **Topic 3.1 Task 3** in their manuals. With their groups from the previous activity, tell them to consider the scenario and discuss the questions that follow:

Rosine owns a ruminant farm and needs to select which animals to breed to maintain optimal meat production. Select one male and one female from the lists below to breed. Explain your choices.

[21] Luginbuhl, J. M. (2015, September 21). *Breeds and production traits of meat goats*. NC State Extension Publications. https://content.ces.ncsu.edu/breeds-and-production-traits-of-meat-goats

[22] Genomia. (n.d.). *Instructions for animal sampling*. https://www.genomia.cz/en/pokyny/

Cattle	
Male	**Female**
A. Long legs; high ability to convert feeds	**A.** Resistant to diseases; matured early
B. Adaptable to changing temperatures; grows fast	**B.** Sensitive to changing temperatures; deep chest

Sheep	
Male	**Female**
A. Average reproduction level	**A.** Rarely lambs
B. Soft, uniform wool coat	**B.** Requires little care

Goats	
Male	**Female**
A. Early and fast growth rate	**A.** High reproduction rate
B. Unusual distribution of muscles	**B.** Sensitive to environmental changes

2. After all the groups have made their decisions, vote on which animals in each category should be selected for breeding. Be sure to cite your evidence! After the voting, verify the correct answers with the trainer.

3. Discuss as a class: How can we keep track of and pass on knowledge about breeding over the years?

4. Review and discuss the term **breed pedigree** and how it can affect your animals over a long period of time.

Application Activity

Topic 3.1 Task 4:

1. Visit a ruminant farm and greet the farmer and any other staff present.

2. Take a tour of the farm and do the following in small groups:

a. Differentiate between dairy and meat cattle. Identify the best cattle according to their purpose.

b. Differentiate between wool and meat sheep. Identify the best sheep according to their purpose.

c. Differentiate between dairy and meat goats. Identify the best goats according to their purpose.

3. After noting your observations, confirm them with the farmer.

4. Use this opportunity to ask any remaining and/or clarifying questions to the farmer. Remember that he/she is a professional in this field!

Points to Remember

- The breeding system, including feeding, housing, and health management, must be considered for a successful ruminant production farm.
- Reproduction indicators must be considered when selecting animals to raise.

Formative Assessment

After carefully reading the following items, answer the following questions individually:

1. Select **all** the choices that apply.
Which of the following are qualities of a good wool production sheep?
   a. Uniform fleece
   b. Average rate of wool production
   c. Fine grade fleece
   d. Soft fleece texture
   e. Fragile fibres

2. List three qualities of a good milk production cow.
   1.
   2.
   3.

3. Complete the following sentences:
   a. …… …… is the most reliable method of sample collection for laboratory analysis.
   b. Choosing animals based on the performance of their parents is called ……. selection. It requires well-kept ……
   c. Consider the …… of animals, meaning their temperament and ease of handling during activities such as milking.

Topic 3.2: Heat detection

Key Competencies:

Knowledge	Skills	Attitudes
1. Describe heat synchronization benefits and methods	**1.** Select heat detection monitoring tools	**1.** Detail-oriented
2. Identify physical heat signs	**2.** Observe heat in animals	**2.** Proactive
3. Describe data to be recorded	**3.** Keep records	**3.** Responsible

Getting Started: What do we know and where are we going?

Topic 3.2 Task 1:

1. With a partner, discuss ruminant reproduction using the following questions:
   a. What do you know about ruminant reproduction?

   b. When is the best time for female ruminants to breed with males?

   c. How can you recognise this ideal time for breeding?

2. Share your responses and discuss as a class.

3. Review the Key Competencies table, which includes the knowledge, skills, and attitudes you will gain by the end of this unit.

Problem Solving Activity

Topic 3.2 Task 2:

1. In order to effectively breed ruminants, farmers must identify the signs of ovulation, which is when eggs are released from a female's ovary and may be fertilised by male sperm cells. The name for this time in an animal's cycle is called **heat or oestrus**.

2. Using your previous knowledge and experience, discuss the following questions in small groups (3-4 people):
   a. What factors do you think farmers monitor to determine a female animal's heat?

   b. How long do you think the heat period lasts?

   c. What do you think the challenges are with detecting animals' heat?

   d. What are the benefits of synchronising all females' heats to occur at the same time?

3. You may not have a lot of knowledge or experience on this subject. Still, try to think critically and apply what you already know about animal behaviour.

4. Share some of your group's ideas and responses to the questions with the rest of the class. Be sure to discuss, agree, and disagree with one another.

5. After a fruitful class discussion, refer to **3.2 Key Facts.** Read the information with your small groups. As you read, do the following:
   - ✓ Check or tick the information that they predicted correctly from **Question 2**.
   - ❖ Star new terms that they are not familiar with and need clarification on.
   - ○ Circle the significance of record keeping for heat detection.

6. After reading and marking **3.2 Key Facts,** share any terms that you starred (*). The trainer will clarify and explain these terms until everyone understands them.

3.2 Key Facts

- **Heat detection:**
  - Identification of signs that come before ovulation in a female ruminant.
  - Key stage in breeding when artificial insemination is practised.
  - Farmers must monitor animals closely to identify their expression of oestrus (sexual receptivity/fertility).
  - Heat period has become shorter over time and more difficult to detect.
  - In order to ensure heat detection, use monitoring tools:
    - Breeding and mounting indicators: Stick to cow's butt and activated by pressure/friction from mounting.
    - Tail markers: Paints, markers, and crayons; inexpensive.

        - Electronic mounting monitors: Wireless transmitter above the tail sends data to a software; more sophisticated but expensive.[23]

- **Heat synchronisation assistance:**
  - To manipulate females' oestrous (heat) cycles so they can all be bred at the same time.
  - Use hormones to synchronise cycles:
    - Progestins: Extend oestrous cycle and keep animals out of heat.
    - Prostaglandins: Shorten oestrous cycle and bring females into heat.
    - GnRH: Cause ovulation.
  - Benefits:
    - Shortens calving interval, so that females conceive earlier in the breeding season.
    - More effective use of artificial insemination to reduce time and labour in detecting each animal's oestrus/heat.
    - More uniform calf crop with similar ages.[24]

- **Heat/oestrus length:**
  - **Cattle:** 14 - 20 hours
  - **Sheep:** 20 - 42 hours
  - **Goats:** 12 - 36 hours

- **Observation of physical heat signs:**
  - **Cattle**
    - Stands and allows other cows to ride her
    - Tries to ride other cows
    - Loss of appetite
    - Head is up, in the air, sniffing and smelling
    - Nervous/excited behaviour
    - Increased vaginal discharge
    - Vulva (vaginal opening) is red and swollen
  - **Sheep**
    - Nervous/excited behaviour
    - Walks along fences

[23] Allice: Genetics & selection. (n.d.). *Good heat detection for organising insemination*. https://www.allice.fr/insemination-reproduction/insemination-on-farms/heat-detection.html

[24] Hall, J. B., Liles, A., & Whittier, W. D. (2009, May 1). *Estrus synchronization for heifers*. Virginia Tech Publications and Educational Resources. https://www.pubs.ext.vt.edu/400/400-302/400-302.html and Graves, W., & Dyer, T. G. (2017, March 28). *Estrous synchronization for beef cattle*. UGA Cooperative Extension. https://extension.uga.edu/publications/detail.html?number=B1232&title=Estrous%20Synchronization%20for%20Beef%20Cattle

- Shakes tail
- Seeks out rams (males), rubs necks or bodies against them
- Slightly swollen vulva (vaginal opening)

- **Goats**
  - Stands to be mounted by males
  - Rapid tail wagging (flagging)
  - Tries to mount other goats
  - Excited behaviour
  - Walks along fences
  - Clear vaginal discharge
  - Swollen, red, or wet vulva (vaginal opening)

- **Record keeping:**
  - All heats must be recorded on a daily basis to improve detection and predict future cycles.
  - Heat expectancy chart: Calendar organised around 21-day cycle.
  - Breeding wheel: Color-coded pins/markings show reproductive events for each animal.
  - Computer-generated action lists: Keep list of animals that need special attention on a specific day.[25]

Guided Practice Activity

Topic 3.2 Task 3:

1. Observe the photos and videos of cattle, goats, and sheep demonstrating various signs of heat.

2. With your group from the previous activity, determine which signs are being displayed in each photo or video.

3. Then, consider the following scenario with your group. One person in each group should write the answers on a piece of paper.

Joan Divine owns a farm with cattle. Breeding season is always very stressful because the female cows experience heat at different times. It is also economically costly because she must hire additional workers to help her monitor all the cows.

[25] O'Connor, M. (2016, May 17). *Heat detection and timing of insemination for cattle*. Penn State Extension. https://extension.psu.edu/heat-detection-and-timing-of-insemination-for-cattle#section-39

a. Explain to Joan Divine the concept of heat synchronisation.

b. Describe the different methods/protocols of heat synchronisation she can use.

c. Explain the benefits of heat synchronisation for her farm.

4. After collaborating with your group, volunteer to share the information for Joan Divine with the rest of the class. Be sure to listen to other groups and give feedback.

5. Verify the correct information with the trainer.

Application Activity

Topic 3.2 Task 4:

1. Visit a ruminant farm and greet the farmer and any other workers present.

2. First, interview the farmer using the questions below as well as some of their own questions. Note the farmer's answer to each question.

Questions	**Answers**
Do you use heat monitoring tools? If so, which one(s)?	
Do you use heat synchronisation on your farm? If so, which method do you use?	
What are the challenges of detecting heat?	
What records do you keep related to heat detection? Why?	
Your question:	
Your question:	

3. After interviewing the farmer, observe the female ruminants alongside the farmer.
   a. Which females are showing signs of heat?

   b. Which females are not showing signs of heat?

4. Confirm your observations with the farmer.

5. After the visit, discuss as a class:
   a. What did you learn?
   b. What surprised you?
   c. What information do you still need?

Points to Remember

- Adequate cow nutrition is necessary to ensure the cows are cycling.
- If 5% of the herd is seen in heat one day, then most of the cows are probably cycling.
- If previous conception rates were not good, then the hormones used to synchronize oestrus will not improve conception rates.
- If a group of ruminants is to be synchronised, then there must be a sufficient amount of handling facilities and manpower to handle the animals.

Formative Assessment

After carefully reading the following items, answer the following questions individually:

1. Name three physical signs of heat for cattle, goats, and sheep:

Cattle	Goats	Sheep
1.	1.	1.
2.	2.	2.
3.	3.	3.

2. Explain the purpose and benefits of heat synchronisation.

3. Complete the following sentences:

a. Heat should be recorded on a daily basis in order to …….. detection and …….. future cycles.

b. The animals' heat periods have become …….. over time and more …….. to detect.

c. In addition to observations of physical behaviour, ……. …… may be used to detect heat more accurately.

Topic 3.3: Artificial insemination and mating assistance

Key Competencies:

Knowledge	Skills	Attitudes
1. Explain the procedures and methods for artificial insemination	**1.** Perform artificial insemination on cattle	**1.** Detail-oriented
2. Explain the benefits of artificial insemination	**2.** Prepare materials, tools, and equipment for artificial insemination	**2.** Precise
3. Identify the reproductive cycles of ruminants and how to diagnosis pregnancy	**3.** Keep proper records of ruminant reproductive cycles	**3.** Proactive

Getting Started: What do we know and where are we going?

Topic 3.3 Task 1:

1. Brainstorm responses to the following questions with a partner:
   a. What is reproduction?

   b. What is insemination?

   c. What is the difference between natural and artificial insemination?

2. After discussing, share your answers and ideas. Try to relate your answers to ruminant farming.

3. Review the Key Competencies table, including the knowledge, skills, and attitudes you will gain by the end of this topic.

Problem Solving Activity

Topic 3.3 Task 2:

1. Separate into small groups (2-3 people).

2. First, consider the difference between natural and artificial insemination from the previous activity. Given what you have learned about ruminant farming, reflect on and brainstorm the benefits of artificial insemination rather than natural insemination.

3. Next, work together to put the following steps for artificial insemination in the correct order.

Set time for insemination	Assemble equipment and supplies
Perform artificial insemination	Collect semen from male
Detect heat in female	Restrain animal
Restrain animal	

Correct Order:

1.

2.

3.

4.

5.

6.

3. After you have determined the steps for artificial insemination, compare your answers with another group. Discuss, agree, and disagree with each other until you both come to a final agreement.

4. Finally, refer to **3.3 Key Facts** to have their ideas from this activity confirmed or corrected. Read through **3.3 Key Facts** as a class. As you read, do the following:

- ✓ Check or tick the benefits of artificial insemination that they guessed correctly.
- o Circle the benefits of artificial insemination that they had not considered.
- ❖ Star any other information that you do not understand and would like more clarification on.

3.3 Key Facts

- **Reproduction background:**
  - Process by which animals produce offspring.
  - Sexual reproduction involves the union of the female's egg with the male's sperm in the female tract.
  - Fertilisation is the union of the egg and the sperm cells.
  - Parents are selected and mated to achieve goals with offspring, such as producing offspring with high milk productivity, large litters, or meaty carcasses.
  - Reproduction results in new animals that are raised for the products they produce. Examples of products include meat, eggs, milk, and wool.

- **Insemination:**
  - Process of placing sperm in the reproductive tract of the female
  - Females must be receptive to males at a time in the oestrus cycle known as heat.
  - **Natural**: When a male of a species mates with a female of the same species. Sperm are placed in the female reproductive tract by the male through copulation.
    - **Copulation (breeding):** Process in which sperm are ejaculated from the penis of the male in the vagina of the female.
  - **Artificial:** Placing semen collected from a male in the female reproductive tract using equipment.

- **Benefits of artificial insemination:**
  - Allows farmers to have greater choices in selecting beneficial traits for improved genetic performance.
  - Reduces risk of diseases spreading and injuries unlike natural mating.
  - Increases number of inseminated cows compared to natural mating.
  - Passes on good qualities from a bull/male cow.
  - Less expensive and dangerous than keeping a bull.
  - Maximum use of outstanding sires: Semen can be used after the sire has died or can be shipped anywhere in the world.
  - Increased uniformity of offspring.
  - Reduced sire cost.
  - Better animal health is maintained.
  - Improved breeding herd records.
  - Increased profits.

- **Limitations of artificial insemination:**
  - Skilled technicians are required.
  - Physiological principles must be followed.
  - Sire market may be limited.

- May increase the damage to a sire.
- Artificial breeding organizations require large investments of capital and competent management.[26]

- **Artificial insemination process:**
  1. Collect semen from male.
  2. Detect heat/oestrus in female.
  3. Set time for insemination.
  4. Assemble equipment and supplies.
  5. Restrain animal.
  6. Perform artificial insemination.

- **Artificial insemination tools, materials, and equipment:**
  - Liquid nitrogen tank to store the semen straws.
  - Straw of semen.
  - Straw tweezers.
  - Sterile lubricant (non-spermicidal) to put on the plastic sleeve and/or the animal's vulva.
  - Insemination gun to hold the straw and manoeuvre it through the cervix.
  - Thaw box to thaw the straw of semen.
  - Paper towels to keep the area clean, especially the animal.
  - Scissors to cut the end of the straw just prior to insemination.
  - Thermometer to measure the temperature of the water bath.
  - Plastic gloves or sleeves to put on the inseminator's arms.
  - Cover sheath.[27]

- **Artificial insemination in cows:**
  - **Recto-vaginal method (most common):**
    1. Wear PPE.
    2. Restrain animal.
    3. Raise tail and massage rectum.
    4. Enter left hand into the rectum to manipulate the reproductive tract.
    5. Wipe the vulva to remove manure and debris.
    6. Press down onto vulva to spread the vaginal lips.
    7. Use right hand to insert and release the insemination gun.[28]

[26] Tamil Nadu Agricultural University. (n.d.). *Artificial insemination*. TNAU Animal Husbandry. https://www.agritech.tnau.ac.in/animal_husbandry/animhus_cattle_AI.html
[27] Azizi, M. (2015, February 16). *Artificial insemination equipment*. LinkedIn SlideShare. https://www.slideshare.net/mohammadazizi4/artificial-insemination-equipment
[28] Infovets. (n.d.). *Reproduction management: Artificial insemination*. https://infovets.com/healthycowinfo/A716.htm

Guided Practice Activity

Topic 3.3 Task 3:

1. In your small groups from the previous activity, read the following scenario and questions:

Thierry is a cattle farmer in the Southern Province. He has detected heat in several of his female cows and plans to artificially inseminate them. He has asked for your advice on the following points:

a. What method of artificial insemination should he use? What are the steps for this method?

b. What are important techniques for restraining the cattle to perform the process?

c. What information should Thierry record about his cattle?

d. How can Thierry test if his cattle have become pregnant? How long after the insemination?

2. Everyone in the group must write the responses down. You should refer to **3.3 and 3.4 Key Facts**, but you should NOT copy the information directly. Instead, you should rephrase the information into your own words.

3. After you have finished working, volunteer to share your responses. Again, you cannot read directly from the **Key Facts**.

4. Verify the correct answers with the trainer.

3.4 Key Facts

- **Mating small ruminants:**
  - Mate all females to give birth at about one year of age.
  - Retain females that wean offspring from first mating. Discard the others.
  - Mate twin males or heaviest singles born from mother's that are one year old.
  - Keep close records to improve mating over time.

- **Sire selection:**
  - Sire**:** Male parent of an animal, especially for breeding.
  - Must assess the bull's ability to get cows pregnant.

- **Perform Breeding Soundness Exam:**
  - Overall physical evaluation
    - Health: Check for clear eyes, adequate number of teeth for grazing, and generally good health.
    - Body Condition: Want bulls with some extra weight, but not too fat or too thin.
    - Body Structure: Check that rear leg conformation is very important, and hooves do not need trimming
  - Examination of reproductive genitalia
    - Check prepuce (foreskin) for inflammation and adhesions
    - Check that penis is parallel to the body
    - Check for normal scrotum conformation
    - Check testes for size, tone, and symmetry
    - Examine sex glands via rectal palpation
  - Semen evaluation
    - Semen tests[29]

- **Restraining techniques:**
  - Arrange restraint area for animal
    - Free of stressful conditions and unnecessary excitement
    - Well-lit with food and water provided
  - Minimise changes in the routine and keep things as normal as possible
  - Use a cattle crush/chute: strong stall to hold cattle safely[30]

- **Record keeping:**
  - Very important to keep updated records of individual cows.
  - Allows veterinarian and farmer to decide whether a particular cow is in trouble or not.
  - Compiling records of individual cows gives a picture of the herd as a whole.
  - Action Lists: Lists of cows that need to be brought up for herd checks, need to be dried off, or another action.
  - Provide farmer with valuable measures of herd performance.

[29] Terrill, C. E. (1986). *Small ruminant production in the developing countries: Introduction*. Food and Agriculture Organization of the United Nations. https://www.fao.org/3/ah221e/AH221E06.htm#ch6

[30] Short, W. (2018, May 20). *8-step guide to artificially inseminating a dairy cow*. Farmers Weekly. https://www.fwi.co.uk/livestock/livestock-breeding/8-step-guide-artificially-inseminating-dairy-cow

- Record should include: ID, date of birth, vaccination record, breeding and heat dates, calving history (dystocia, RFM (Retained Foetal Membranes)), mastitis, other health history information, reproductive exam information.[31]

- **Return to heat:**
  - **Reproductive cycle of cattle:** 17 to 24 days
  - **Reproductive cycle of sheep:** 16-17 days
  - **Reproductive cycle of goats:** 19-21 days[32]

  - **Pregnancy diagnosis**
    - Biochemical and hormonal tests
    - Determine the level of Pregnancy Associated Glycoproteins (PAGs) in the animal's blood
    - PAGs are specialized in developing placenta
    - Test 28 days or more after last mating/artificial insemination
    - Very accurate[33]

Application Activity

Topic 3.3 Task 4:

1. Visit a local ruminant farm and greet the farmer and any other staff.

2. First, observe the tools, materials, and equipment used for artificial insemination. Identify the different tools, materials, and equipment and their uses. Finally, ask the farmer to confirm or correct your observations.

3. Then, ask the farmer about his or her record keeping procedures.
   a. What information do you record?

   b. How are these records beneficial?

   c. What are the challenges of good record keeping?

[31] Terrill, C. E. (1986). *Small ruminant production in the developing countries: Introduction*. Food and Agriculture Organization of the United Nations. https://www.fao.org/3/ah221e/AH221E06.htm#ch6
[32] Tamil Nadu Agricultural University. (n.d.). *Breeding management of sheep and goat: Introduction*. TNAU AgriTech. https://agritech.tnau.ac.in/expert_system/sheepgoat/Breeding%20Management%20of%20Sheep%20and%20Goat.html
[33] Washington Animal Disease Diagnostic Laboratory. (2019, June). *Pregnancy testing in ruminants*. https://waddl.vetmed.wsu.edu/animal-disease-faq/pregnancy-testing-in-ruminants

4. Finally, if possible, observe the farmer as he or she demonstrates how to perform artificial insemination. You may assist the farmer if he or she requests it.

5. After the visit, discuss as a class:
   a. What did you learn?
   b. What surprised you?
   c. What knowledge and/or skills do you still need to perform artificial insemination?

Points to Remember

- Pregnancy Associated Glycoproteins (PAGs) test is a very accurate test for diagnosing pregnancy in animals.
- Accurate and detailed records provide the farmer with valuable measures of herd performance in the long-term.
- Skilled technicians and appropriate equipment are required to perform artificial insemination.

Formative Assessment

After carefully reading the following items, answer the following questions individually:

1. List four data points that should be collected for record keeping related to insemination.
   1.
   2.
   3.
   4.

2. Complete the following sentences:
   a. The restraint area for animals should be free of …….. conditions, well-lit, and have …… and ……. Provided.

   b. A liquid nitrogen tank is used to store the …… ……

   c. Artificial insemination may increase the …….. to a sire.

3. Explain the difference between natural and artificial insemination.

Topic 3.4: Monitoring pregnancy

Key Competencies:

Knowledge	Skills	Attitudes
1. Describe the different signs of pregnancy	**1.** Identify the signs of pregnancy	**1.** Proactive
2. Explain methods used in pregnancy diagnosis	**2.** Perform rectal palpation on cattle	**2.** Methodical
3. Explain how estimate the stage of pregnancy during a rectal palpation	**3.** Estimate the stage of pregnancy using a rectal palpation	**3.** Precise

Getting Started: What do we know and where are we going?

Topic 3.4 Task 1:

1. Find a partner and discuss the following questions:
   a. How do you know when a woman is pregnant?

   b. How do you know when a ruminant is pregnant?

   c. What parts of the body (internal) are affected by pregnancy?

   d. How could you assess these internal body parts/organs?

2. Share your responses and discuss as a class. Correct any major misconceptions you have about pregnant ruminants.

3. Review the Key Competencies table with the knowledge, skills, and attitudes you will gain by the end of this topic.

Problem Solving Activity

Topic 3.4 Task 2:

1. With your partner from the previous activity, complete the following task found in. Predict how each body part or function changes when a ruminant is pregnant. **Part a** has been done as an example.
   a. *Body weight - increases*
   b. Womb
   c. Skin
   d. Pulse rate
   e. Udder
   f. Body temperature

2. After predicting, compare your ideas with another group. Discuss and debate your predictions, using previous knowledge and experience as evidence.

3. The easiest, fastest, and most accurate method to determine a cow's pregnancy is through rectal palpation. Observe a photo of a cow's reproductive organs/anatomy. A strong knowledge of these parts is essential to performing a rectal palpation. With the trainer, identify the following parts from the photo:
   a. Cervix
   b. Rectal passage
   c. Vulva
   d. Uterus
   e. Uterine horns

4. Now, direct trainees to **3.5 Key Facts**. Read the information out loud as a class.
   a. While reading about signs of pregnancy, confirm or correct your predictions from **Question 1**.

   b. While reading about rectal palpation, refer to the image(s) displayed as well as those in **3.5 Key Facts** so that you can visualise this process.

5. Ask questions to clarify any misunderstandings or confusion from **3.5 Key Facts.**

3.5 Key Facts

- **Signs of pregnancy:**
  - Increase in body weight.
  - Enlarged womb.
  - Flank regions become hollow as the spine and tail root become prominent.
  - Smooth and shiny skin.
  - Sticky and thick mucus seals the cervix.
  - Thick secretion from the teats at 4-5 months of gestation.
  - Increased progesterone in mother's blood and urine.
  - Signs of life of the foetus.
  - Udder tissues, especially in first pregnancy animals.
  - Increase in pulse rate.
  - Body temperature becomes slightly higher than normal.

- **Different ways to diagnosis pregnancy:**
  - Recto palpation (cattle/large ruminants)
  - Vaginal examination
  - Abdominal palpation
  - Radiography/X-ray
  - Vulva condition
  - Udder secretion in heifers
  - Progesterone estimation

- **Rectal palpation in cattle:**
  - Easiest, fastest, cheapest method.
  - Most accurate method.
  - Determines pregnancy status 35 days post breeding.
  - Materials needed: plastic gloves, oil/lubricant, cattle crush/chute for restraint

- **Technique of pregnancy diagnosis by rectal palpation of a retractable uterus**
  1. Feel the uterus for asymmetry. At 35 days of pregnancy, the pregnant horn will feel slightly larger.
  2. Feel for fluid in the larger horn. The fluid has a smooth velvety feel because the uterine wall thins during pregnancy.
  3. Systematically feel the uterus for the amniotic vesicle, the foetal membrane slip, or the foetus. Always follow the golden rules of pregnancy diagnosis (see below).
  4. Other signs suggestive of pregnancy are fremitus, which is a hypertrophy of middle uterine artery. The middle uterine artery can be picked up in the broad

ligament and moved around. There is a fluid turbulence that gives a 'buzz' feeling to the artery.[34]

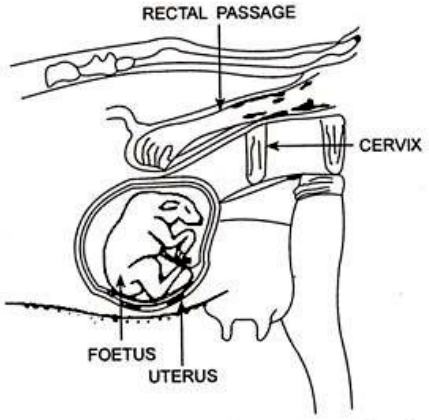
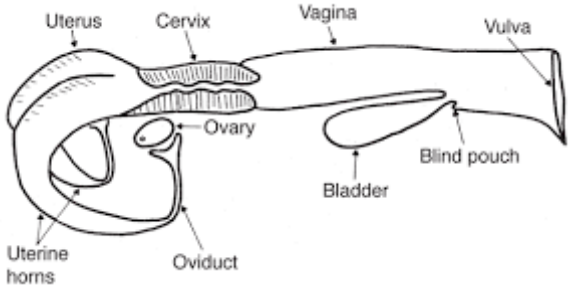


FIG. 24.1. Observations to be made are given in Table 24.1.

35



36

- **The Golden Rules of rectal pregnancy exam:**
  - Examine the entire tract before declaring the cow open.
  - Find one of the positive signs of pregnancy before you call a cow pregnant.
  - Pregnancy examination must always be the first step in your examination. If you are not sure, recheck the cow...maybe in a few minutes, maybe tomorrow.
  - Positive signs of pregnancy: foetus, cotyledons/caruncles, amniotic/embryonic vesicle, and foetal membrane slip.[37]

[34] Eilts, B. E. (2012, September 25). *Pregnancy examination of the cow*. Louisiana State University Department of Veterinary Clinical Sciences. https://therio.vetmed.lsu.edu/bovine_pregnancy.htm

[35] Mondal, P. (n.d.). *FIG 24.1. Observations to be made are given in Table 24.1* [Figure]. Your Article Library. http://www.yourarticlelibrary.com/dairy-farm-management/pregnancy-diagnosis-of-animals-importance-methods-and-procedures/35867

[36] Turner, J. L. (n.d.). *Figure 1. Diagram of the reproductive tract of the cow. (Adapted from Rich and Turman, n.d.)* [Figure]. New Mexico State University College of Agricultural, Consumer and Environmental Sciences. https://aces.nmsu.edu/pubs/_b/B212/welcome.html

[37] Eilts, B. E. (2012, September 25). *Pregnancy examination of the cow*. Louisiana State University Department of Veterinary Clinical Sciences. https://therio.vetmed.lsu.edu/bovine_pregnancy.htm

Guided Practice Activity

Topic 3.4 Task 3:

1. Separate into small groups (2-4 people) and consider the following scenario and questions:

Christian raises cattle in the Eastern province. He artificially inseminated several cows and wants to determine if they are pregnant or not. He plans to perform a rectal palpation exam, but he is nervous because it will be his first time doing this procedure. He asks for your advice on the following points:

a. What materials do I need to do a rectal exam?

b. What are the positive signs of pregnancy?

c. What if I am not sure about the cow's pregnancy diagnosis after I complete the exam?

d. What are the main body parts/organs that I should be familiar with for this exam?

2. Discuss and write the answers with your group. Once all groups have finished, share your ideas. After all the questions have been addressed, verify the correct answers with the trainer.

3. Now, consider the following information:

Christian completes the rectal palpation procedure and determines that the cow is pregnant. He records that one of the uterine horns is enlarged and the walls are thinner. He feels a foetus that is about 2.5 cm long.

4. Refer to **3.6 Key Facts** and read the facts with your group to determine which stage of pregnancy Christian's cow is in.

5. After the groups have discussed, verify your answer with the trainer.

6. Ask questions to clarify any misunderstandings or confusion about **3.6 Key Facts**.

3.6 Key Facts

- **Estimating pregnancy stages:**
  - **30-Day Pregnancy**
    - Use breeding records as a guide.
    - One uterine horn is enlarged – the embryonic vesicle.
    - Uterus is filled with fluid and feels thinner.
  - **45-Day Pregnancy**
    - Embryo attaches to the uterine wall and becomes a foetus; about 2.5 cm long.
    - Uterine horn that contains the foetus is larger and its walls are thinner.
    - Be careful not to move the foetus or it could detach and die.
  - **60-Day Pregnancy**
    - One uterine horn is now the size of a banana and is 20-25 cm long.
    - Gently tap the uterus and you should feel the foetus swing back and forth against the wall of the uterine horn.
  - **90-Day Pregnancy**
    - Foetus is 16 cm long.
    - Press against the left side of the pelvis to feel the uterine artery.
    - Uterine artery should be about ½ cm in diameter and buzzing/whirring/pulsing as blood moves through it.
    - Or, look for cotyledons on the uterus—flattened, egg-shaped masses; firmer than the uterus; 2-2.5 cm long.
  - **120-Day Pregnancy**
    - Foetus is 25-30 cm long.
    - Cotyledons are 1.5-4 cm long.
    - Uterine artery is ½ cm diameter.
  - **150-Day Pregnancy**
    - Foetus size is 40 cm long; size of a large cat.
    - Cotyledons are 5-6 cm long.
    - Uterine artery is 1/4-1 cm diameter.
  - **180-Day Pregnancy**
    - Uterine artery is 1-1.2 cm diameter.
    - Cotyledons are larger.
    - Foetus can move with its feet, legs, or nose.
  - **7 Months+**
    - Foetus is easily felt due to its size.[38]

[38] Instructional Materials Service Texas A&M University. (2002). *Pregnancy diagnosis (palpation)*. https://www.birdvilleschools.net/cms/lib/TX01000797/Centricity/Domain/1390/Pregnancy%20and%20Palpation%20Lesson.pdf

- **Reasons to estimate pregnancy stage:**
  - There may be lost records and you need to predict dry off dates.
  - May need to stage pregnancy if records are not kept or a bull runs with the herd.
  - May need to confirm artificial insemination dates, or an A.I. date may not match what you feel.
  - May be asked to estimate parturition dates for beef herds.

Application Activity

Topic 3.4 Task 4:

1. Visit a local ruminant farm and greet the farmer and any other staff.

2. Observe the pregnant cow(s) and note any signs of pregnancy in the chart below. Measure the last two (pulse rate and body temperature) with the farmer's assistance, if possible.

Body part/function	Description
Body weight	
Skin	
Udder	
Pulse rate	
Body temperature	

3. Next, observe closely while the farmer demonstrates how to perform a rectal palpation on one of the pregnant cows.

4. Based on the farmer's experience and description, determine which stage of pregnancy the cow is in by referring to **3.6 Key Facts**.

5. Ask the farmer any questions you have about rectal palpation and how to master this skill.

6. After the visit, discuss as a class:
   a. What did you learn?
   b. What surprised you?
   c. What information do you need about monitoring pregnant ruminants?

Points to Remember

- Always be systematic in your rectal examination.
- Observe the Golden Rules of pregnancy diagnosis by rectal palpation.

Formative Assessment

After carefully reading the following items, answer the following questions individually:

1. List five signs of ruminant pregnancy:

2. Why should someone use the rectal palpation pregnancy diagnosis method for cattle?

3. Complete the following sentences regarding the Golden Rules of the rectal pregnancy exam:
   a. Be sure to examine the entire ……..

   b. In order to determine that a cow is pregnant, you must find one of the …… ……

   c. If you are not sure of the animal's pregnancy status after the exam, you must ……. the cow later.

Topic 3.5: Parturition assistance

Key Competencies:

Knowledge	Skills	Attitudes
1. Know the various signs of parturition	**1.** Identify females during parturition time	**1.** Precise
2. Explain how to care for mothers and newborns immediately after birth	**2.** Prepare maternity room	**2.** Patience
3. Identify newborns using ear tag or tattoos	**3.** Apply ear tags and tattoos to newborns	**3.** Proactive

Getting Started: What do we know and where are we going?

Topic 3.5 Task 1:

1. Discuss the following questions with a partner. Apply your previous knowledge and experiences.

a. How do you know when an animal is going to give birth soon?

b. Have you ever seen a ruminant give birth? What did it look like?

c. What precautions should you take when assisting with a ruminant birth?

2. After discussing, volunteer to share your answers with the rest of the class. Discuss with the full class on the topic of ruminant births, or parturition. Discuss freely; the correct answers will be revealed throughout this topic.

3. Review the Key Competencies table, which includes the knowledge, skills, and attitudes they will gain by the end of this topic.

Problem Solving Activity

Topic 3.5 Task 2:

1. With your partner from the previous activity, work together to determine if the following statements are true or false. Discuss and debate the statements, using your own experience and previous knowledge as evidence.
   a. It is better for ruminants to give birth naturally.

   b. Animals giving birth for the first time will not have any problems compared to older animals.

2. The correct answers will be confirmed in **3.7 Key Facts**. But before reading the **Key Facts**, discuss the following situation with your partner:

   One of your cows is giving birth. You are expecting the head to come out first and then both front feet. However, only the head has come out.
   a. What should you do?

   b. Why?

   c. What are the potential consequences?

3. After the discussions, volunteer to share your ideas and explain your reasoning.

4. Then, refer to **3.7 Key Facts**. Read the sections out loud as a class. While reading, do the following:
   a. Confirm whether the statements from **Question 1** are true or false.

   b. Confirm what you should do if you face difficulties during calving, such as the scenario from **Question 2**.

   c. Underline or circle any other information that is unclear or confusing.

5. After reading, clarify any misunderstandings or confusion from **3.7 Key Facts**.

3.7 Key Facts

- **Parturition:**
  - Action of giving birth to a child/baby.
    - **Calving**: When a cow gives birth to a calf.
    - **Lambing**: When a sheep gives birth to 1-3 lambs.
    - **Kidding**: When a goat gives birth to 1-3 kids (baby goats).
  - Natural process which normally takes place without help.
  - Close observation is required in case the animal has difficulties.
  - Animals calving for the first time tend to have more problems than older cows and therefore need more attention when giving birth.

- **Signs of calving:**
  - **Physical signs:** Changes in the body itself
    - Increased belly size, especially on the right side.
    - Udder fills up; teats stiffen.
    - Vulva is red and swollen.
    - Mucous and blood-coloured fluid string coming from the vulva/vaginal opening.
    - Water bag forms at the vulva.
  - **Physiological signs**: Changes in the body's functions
    - Restless behaviour.
    - Stays away from the herd.
    - Reduced appetite.

- **Normal calving process:**
  - Water bag appears through the vulva.
  - Cow will strain more.
  - Head of the calf will appear and break the bag.
  - You can then see the calf's front feet.
    - Sometimes the back feet of the calf appear first. You should then look (or feel with your hands) for the tail and the hock joints.
  - Takes 4-6 hours for the calving to reach this stage; might take longer for heifers.
  - As the chest comes through the vagina, the calf starts to breathe.

- **Tips for calving:**
  - It is better to leave the cow alone to give birth naturally.
  - If you want to help with the calving, you can gently pull the calf by its feet.
  - If the navel cord is still attached to the cow, you can cut it with a clean sharp knife or a pair of scissors, then put tincture of iodine or alcohol on the end of the navel cord.

- **Calving difficulties:**
  - Possible difficulties:
    - Only the head of the calf has appeared.
    - Head and one foot have come out.
    - Two front feet showing but no head.
  - Ask the veterinarian to help or help the cow yourself.
    - Use a bar of soap, hot water, a clean rope and clean vegetable oil, such as olive or sunflower oil.
    - Wash your hands and the area around the vulva well.
    - Put some oil on your hands and arm and insert it into the vagina to discover what is wrong.
    - Recognize the difference between the front and back legs of the calf in the womb. Touch the fetlock joint and then run your hand up the leg to the next joint. There will be a knee joint on the front leg and a hock on the back leg. Push the calf either to one side or back into the uterus so that you can correct the situation and move the head and legs into the right place for birth.[39]

- **Signs of lambing/kidding:**
  - Animal stays away from others.
  - Vulva is swollen and the skin is loose.
  - Animal becomes restless and does not eat a lot.
  - Discharge from the vulva will start a few days before parturition.
  - Sheep will lie down and stretch the neck back to look at the sky (star gazing) and lick its lips.
  - Sheep will strain to push out the lamb.

- **Normal lambing/kidding process:**
  - Animals may give birth while standing or lying down.
  - Head and both front legs appear or sometimes both the hind legs will appear.
  - Young mother may have some problems in giving birth.[40]

[39] Food and Agriculture Organization of the United Nations. (1994). *A manual for the primary animal health care worker: Unit 19: Calving (parturition)*. https://www.fao.org/3/t0690e/t0690e05.htm#unit%2019:%20calving%20(parturition)

[40] Food and Agriculture Organization of the United Nations. (1994). *A manual for the primary animal health care worker: Unit 20: Lambing and kidding (parturition)*. https://www.fao.org/3/t0690e/t0690e05.htm#unit%2020:%20lambing%20and%20kidding%20(parturition)

Guided Practice Activity

Topic 3.5 Task 3:

1. Divide the trainees into small groups (2-4 people). With your group, compare and contrast the signs of parturition for cattle to the signs for sheep and goats using **3.7 Key Facts**.

Signs that are the same/similar:	Signs that are different:

2. Observe photos of animals showing signs of parturition on the projector. Discuss and identify the signs shown by each animal. Verify your responses with the trainer after each photo.

3. Next, refer to **3.8 Key Facts**. This section of **Key Facts** covers how to care for mothers and newborns before and after parturition. Read through each section as a class. As you read, do the following:

- Underline the three things to check in a mother immediately after birth.
- Star the two things to check in a newborn immediately after birth.
- Circle the two methods of newborn identification.

4. After reading, share the information you underlined, starred, and circled while reading.

3.8 Key Facts

- **Preparing the maternity room:**
  - Separate, well-ventilated area.
  - Sand or grit floor covered with bedding.
  - Do not keep pregnant animal inside; allow her to exercise in a nearby field or yard.
  - Observe pregnant animal twice per day.[41]

[41] Food and Agriculture Organization of the United Nations. (1994). *A manual for the primary animal health care worker: Unit 18: Pregnancy in ruminants*. https://www.fao.org/3/t0690e/t0690e05.htm#unit%2018:%20pregnancy%20in%20ruminants

- **Caring for the mother:**
  - Immediately give the mother clean water to drink.
  - The water bag should come out naturally, but you can help to remove it by gently pulling it.
    - Water bag should have come out by 3 hours (lambs and goats) or 24 hours (cows) after the birth.
    - If it remains in the uterus, it will cause an infection and you will need to get your veterinarian to help.
  - Check that she is producing milk for young to drink (colostrum).
    - Might need to squeeze some milk out of teats to help newborns.
    - If triplets, try to foster one child on another mother.
  - Check that there are not any dead young in the uterus.
    - If there are, remove them to prevent an infection.

- **Caring for the newborn:**
  - Vulnerable to disease.
  - Dependent on mother for food and survival.
    - If mother dies in parturition process, must provide a foster mother.
  - Perform castration, tail cutting, and dehorning while they are young to reduce risks and stress.
  - Check navel cord and apply small amount of iodine, gentian violet, or Dettol immediately after birth.
    - Repeat 2-3 days later.
    - After one week, cord should have dried and dropped off.
    - If there is in infection, treat it as a wound.
  - Check for extra teats, especially for calves. To remove them:
    - Restrain the animal firmly.
    - Identify the extra teat(s) for removal.
    - Use a pair of clean, sharp scissors to cut off the teat flush with the skin.
    - Dress the wound with tincture of iodine or antibiotic powder.[42]

- **Identification of newborns:**
  - **Ear tags**
    - Used globally.
    - Aids with biosecurity programs and tracing animals.
    - Helps gather information for management and health decisions.
    - Improves farm productivity and supply chains.

[42] Food and Agriculture Organization of the United Nations. (1994). *A manual for the primary animal health care worker: Unit 21: Care of the newborn*. https://www.fao.org/3/t0690e/t0690e05.htm#unit%2021:%20care%20of%20the%20newborn

- **Tattoos**
  - Long-lasting marks, designs, or patterns on the skin.
  - Prick and rub dyes or stains on the skin.
  - Machines are available.

Application Activity

Topic 3.5 Task 4:

1. Visit a local ruminant farm and greet the farmer and any other staff present.

2. Follow the farmer to the pregnant animals. Referring to **3.7 and 3.8 Key Facts**, do the following:

a. Observe the maternity room and note the arrangement (lighting, water, food, etc.):

b. Observe the pregnant animal(s). Check or tick the signs of parturition that you observe:

✓	**Signs of parturition**
	Increased belly size
	Filled udder
	Stiff teats
	Red and swollen vulva
	Mucous and blood-coloured fluid from vulva
	Presence of water bag
	Animal is away from others
	Restless behaviour
	Animal is straining

c. If possible, observe as an animal gives birth. Assist the farmer if requested. Pay close attention to the animal's behaviour and the farmer's actions before, during, and after the parturition.

d. If it is not possible, ask the farmer to explain in detail the process of parturition for cows, sheep, and goats. Ask many questions.

3. After the visit, discuss as a class:

a. What did you learn?

b. What surprised you?

c. What other information do you need about ruminant parturition?

Points to Remember

- Remember that most newborn animals die because of lack of food. Cold and wet conditions are very bad for newborns and can cause lung diseases which may kill them.
- Lambing and kidding, like calving, are natural processes which normally take place without help. Observation is required in case there are any difficulties.
- Sheep and goats, unlike cattle, may frequently have twins (2 young) or triplets (3 young).
- Cows calving for the first time (heifers) tend to have more problems than older cows and therefore need more attention when calving.
- From birth, the young animal is vulnerable to disease and is completely dependent on the mother for food for survival.

Formative Assessment

After carefully reading the following items, answer the following questions individually:

1. Circle the signs of lambing/kidding from the list below:
   a. Animal behaviour is violent.
   b. Discharge from the vulva.
   c. Animal begins to strain.
   d. Vulva skin is tight and dry.
   e. Animal stays away from others.

2. What should you do if there are difficulties during calving?

3. Complete the following sentences:
   a. The mother's …… ……. should come out naturally, but you can help remove it by pulling on it.

   b. Check that there are not any ……. …….. in the uterus because they could cause an …….

   c. …… ……. are used globally to identify newborns.

Topic 3.6: Weaning

Key Competencies:

Knowledge	Skills	Attitudes
1. Identify the duration of lactation periods	**1.** Differentiate the lactation periods of each type of ruminant	**1.** Precise
2. Explain the transition from milk to dry feed	**2.** Transition weaning animals from milk to dry feed	**2.** Methodical
3. Describe how to install weaned animals in their sections	**3.** Install weaned animals according to various purposes	**3.** Detail-oriented

Getting Started: What do we know and where are we going?

Topic 3.6 Task 1:

1. Discuss the following questions with a partner:
   a. What does a newborn animal eat/drink for nourishment?

   b. Where does this nourishment come from?

   c. What does the term “weaning” mean?

   d. Why is it important?

2. After discussing, share your ideas with the rest of the class.

3. Review the Key Competencies table with the knowledge, skills, and attitudes they will gain by the end of this topic.

Problem Solving Activity:

Topic 3.6 Task 2:

1. Separate into small groups (2-3 people). Using the resources available to you (internet, books, other staff/professionals), research definitions of the following terms:
   a. Rumen

   b. Lactation

   c. Weaning

2. After researching the terms, research and write an explanation how the three terms relate to each other, specifically with ruminant animals. Your group should research, understand, and rephrase the information using your own words.

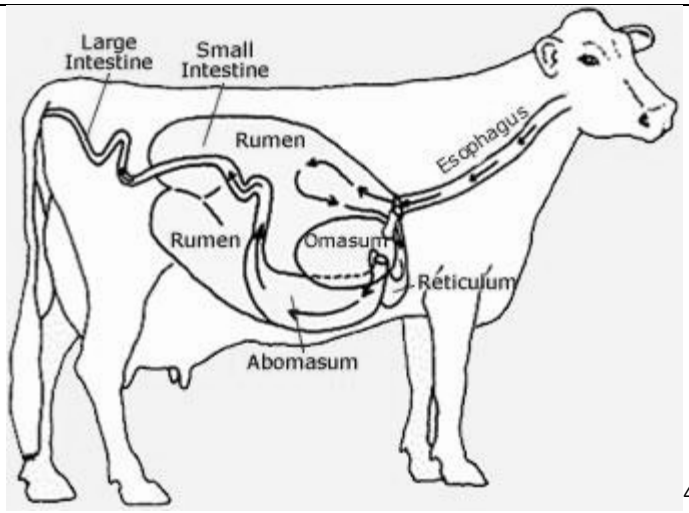
3. Share your group's explanation of the relationship between rumens, lactation, and weaning. Clarify any errors with the trainer.

4. Refer to **3.9 Key Facts**. Read through the information as a class. As you read, do the following:
   - ❖ Star the terms rumen, lactation, and weaning.
   - ○ Circle any information that is confusing or unclear.

5. After reading, share the information you circled. The trainer will clarify the information as needed.

3.9 Key Facts

- **Weaning calves**
  - Weaning is a period when a young animal stops depending on its mother for milk/nourishment.
  - The young one is slowly introduced to solid food as well as searching for food.
  - After two weeks, a calf should be able to eat small amounts of good quality feed such as young grass.
  - Weaning is necessary for the development of the rumen.



[43]

- **Weaning period**
  - **Calves for meat:**
    - Can stay for as long as they want; approximately 7-8 months of age.
  - **Calves for milk/dairy:**
    - Weaned earlier; between 8-10 weeks of age.
    - So that milk can be collected and sold instead of consumed by calf.
  - **Lambs and kids:**
    - Between 4 weeks and 5 months of age.
    - Depends on the management system.[44]

- **Lactation:**
  - Period of time that a mother produces milk to feed her young.
  - **Cow lactation:**
    - Stage 1 - Early: 14 to 100 days.
    - Stage 2 - Mid: 100 to 200 days.
    - Stage 3 - Late: 200 to 305 days.
  - **Sheep lactation:**
    - About 240 days/8 months.
  - **Goat lactation:**
    - 290 to 305 days.[45]

[43] CM Biology Notes. (2017). *Diagram showing the stomach and movement of food* [Diagram]. https://cmbiologynotes.wordpress.com/topics-covered/cellulose-digestion-in-ruminants/
[44] Food and Agriculture Organization of the United Nations. (n.d.). *After the calf is born*. https://www.fao.org/ag/againfo/themes/documents/pub6/p604.htm and Economides, S. (1985). *Small ruminant production in the developing countries: Nutrition and management of sheep and goats*. Food and Agriculture Organization of the United Nations. https://www.fao.org/3/ah221e/AH221E05.htm
[45] Holstein Foundation. (2017, November). *Milking and lactation*. https://www.holsteinfoundation.org/pdf_doc/workbooks/Milking_Lactation_Workbook.pdf and

- **Transition from milk to dry feed**
  - Marks change in rumen development/digestive system.
  - Begin by introducing starter/concentrates gradually and increase each day.
  - Gradually decrease milk consumption and replace with water and dry feed.
    - Clean, fresh water: Allows microbes to form and grow in the rumen.
    - Good quality dry feed for successful transition: Microbes need source of nutrients in order to grow.
  - Importance: Critical growth period of ruminants
    If they struggle at weaning, they lose those days of growth permanently.
    Will be a waste of food/resources to feed the animal if they cannot digest it and grow from it.[46]

- **Installation of weaned calves, lambs, and kids**
  - Must separate from mother for complete weaning.
  - Keep young in familiar place and move mothers to separate area.
  - Provide sufficient dry feed/roughage, water, and shade.

Guided Practice Activity

Topic 3.6 Task 3:

1. In your groups from the previous activity, read the following scenario and questions. Use **3.9 Key Facts** for reference but do not copy the information directly.

One of Jean Baptiste's dairy cattle recently gave birth to a calf. He knows that the calf needs to be weaned but he lacks the essential information for this process. Help Jean Baptiste by discussing and writing the following:

a. Explain the significance and role of weaning in ruminant farming.

b. Identify when a dairy cow's calf should be weaned.

c. Describe how to transition the calf from milk to dry feed.

Sheep milk production: Milking sheep. (n.d.). Milking Sheep. https://www.milkingsheep.com/sheep-milk-production

[46] Proctor, A. (2019, August 27). *The great transition: Turning calves into functioning ruminants*. Form-A-Feed. https://formafeed.com/the-great-transition-turning-calves-into-functioning-ruminants/

d. Describe how the calf should be installed after weaning.

2. After the groups have discussed and written their advice to Jean Baptiste, pair them with another group to compare and contrast their responses. Encourage the groups to explain their reasoning to one another and come to a common agreement.

3. Review the correct answers with the trainees by referring to **3.9 Key Facts**.

4. Finally, ask the trainees how the weaning process differs for calves, lambs, and kids. After some discussion, explain that the weaning periods differ for each type of animal AND their purpose (milk, meat, etc.). The lactation period (time mother produces milk) also differs, which means that the amount of milk the mother can produce for consumption and/or sale is different. They can find the specific numbers in **3.9 Key Facts.**

Application Activity

Topic 3.6 Task 4:

1. Before visiting a local ruminant farm, work in your group to create a list of five interview questions about weaning for the farmer. Write your questions on a separate piece of paper.

2. Share your group's questions. As a class, vote and agree on the five best questions to ask the farmer. Write these questions into the chart below:

Questions	Answers

3. Visit a local ruminant farm and greet the farmer and any other staff present.

4. Take turns interviewing the farmer using the questions you created earlier. Note the farmer's responses in the chart.

5. After the interview, the farmer will guide you to the weaning area. Closely observe what you see. The farmer will explain the following points for these specific animals:

a. Age of young animals.

b. When they will be/were weaned.

c. The transition from milk to dry food and the types of dry food provided.

d. How they will be installed at the farmer after weaning.

5. After the visit, discuss as a class:

a. What did you learn?

b. What surprised you?

Points to Remember

- The smaller the animal, the higher the nutritional requirement will be for milk/feed/ nourishment.
- Feed a high-quality ration from the first day. Hay alone is not enough for young calves.
- Does not change the amount or type of feed suddenly – ease off and on, to allow the rumen microorganisms to adapt and to reduce stress.
- Very weak or sick calves may need to be separated and treated as a hospital group.

Formative Assessment

After carefully reading the following items, answer the following questions individually:

1. Match the ruminant to its lactation period:

Ruminant	Lactation Period
1. Sheep	**A.** 290-305 days
2. Cow	**B.** 240 days
3. Goat	**C.** 14-305 days

2. Explain the difference between weaning calves when the mother's purpose is meat production vs. when the mother's purpose is milk production.

3. Complete the following sentences about installing weaned infants:

a. Weaned infants must be separate from their …… for complete weaning.

b. Keep young in a …… place.

c. Be sure to provide enough roughage, ……, and shade to weaned animals.

Self-Reflection

1. You have come to the end of the unit. You are going to do the survey you did at the beginning of the unit again to help you do self-assessment of your knowledge, skills, and attitudes.

Again, there are no right or wrong answers to this survey. It is for your own use to gauge your knowledge, skills and attitudes after the unit. Read the Knowledge, Skill or Attitude in the left column. Think about yourself: do you think you can do this? How well? Read the statements across the top. Put a check in column that best represents your situation.

My experience Knowledge, skills, and attitudes	I don't have any experience doing this.	I know a little about this.	I have some experience doing this.	I have a lot of experience with this.	I am confident in my ability to do this.
Select ruminant breeds according to production purpose					
Check breed pedigree based on data record					
Assist in heat synchronisation					
Detect heat based on physical signs					
Keep records					
Restrain animals					
Assist with artificial insemination					
Assist with goat/sheep mating					
Assist with pregnancy diagnosis					
Observe calving and kidding signs					
Prepare maternity areas					
Assist with parturition					
Care for calving and kidding females and newborns					
Identify newborns					
Determine weaning period					
Perform weaning					
Install weaned calves and kids in boxes					

2. Complete the table below by identifying areas from the unit where you have improved and where you need improvement with the actions/strategies you will use to help you improve when receiving and interpreting information at the workplace.

Areas of strength	Areas for improvement	Actions to be taken to improve
1. **2.**	**1.** **2.**	**1.** **2.**

Unit 4: Milking operations

Topics

4.1 Hygiene and safety measures

4.2 Milking techniques

4.3 Milk storage and transportation

Unit Summary:

This unit describes the skills, knowledge, and attitudes required to carry out milking operations. At the end of this unit, trainees will be able to apply hygiene and safety measures, apply milking techniques, and store and transport milk.

Self-Assessment: Unit 4

1. Look at the illustration. What is happening? What do you think this unit will be about? What topics might be covered?

2. Fill in the self-assessment below.

There are no right or wrong ways to answer this survey. It is for your own use during this course. The trainer will read a skill that is listed in the left column. Think about yourself: do you think you can do this? How well? Read the statements across the top. Put a check in column that best represents your situation. At the end of this unit, we'll take this survey again.

My experience **Knowledge, skills, and attitudes**	**I don't have any experience doing this.**	**I know a little about this.**	**I have some experience doing this.**	**I have a lot of experience with this.**	**I am confident in my ability to do this.**
Ensure animal hygiene for milking					
Check udder pathology					
Clean materials					
Apply isolation measures for sick animals					
Diagnose udder pathology					
Choose milking methods					
Perform hand milking					
Use milking machine					
Select milk storage material and equipment					
Clean material and equipment for milk storage					
Identify cleaning materials					
Identify milk transportation material					
Perform milk storage					

Topic 4.1: Hygiene and safety measures

Key Competencies:

Knowledge	Skills	Attitudes
1. Recognise udder pathologies/diseases	**1.** Treat and prevent udder pathologies/diseases	**1.** Proactive
2. Describe cleaning procedures for milking materials and areas	**2.** Clean milking materials and areas	**2.** Methodical
3. Identify components of proper hygiene for the milker	**3.** Maintain milker's hygiene	**3.** Detail-oriented

Getting Started: What do we know and where are we going?

Topic 4.1 Task 1:

1. Find a partner and brainstorm responses to the following questions:
   a. What is "hygiene"?

   b. Why is hygiene important in farming?

   c. How could good or bad hygiene impact ruminant health and production?

2. Share your ideas with the rest of the class. Correct any major misconceptions or misunderstandings.

3. Review the Key Competencies table with the knowledge, skills, and attitudes you will gain by the end of this topic.

Problem Solving Activity

Topic 4.1 Task 2:

1. With your partner, discuss and write down how you can maintain hygiene in the following components of milking:

a. Animal (udders)

b. Materials (milking machine, cans/containers, milking area)

c. Milker (hands, clothes, general health)

2. After discussing and writing your ideas, find another pair and compare your ideas. Be sure to agree, disagree, and explain your reasoning.

3. Next, share your ideas as the trainer writes them on the board/flipchart for everyone to see.

4. After brainstorming as a class, refer to **4.1 Key Facts.** Read the information as a class. As you read, do the following:

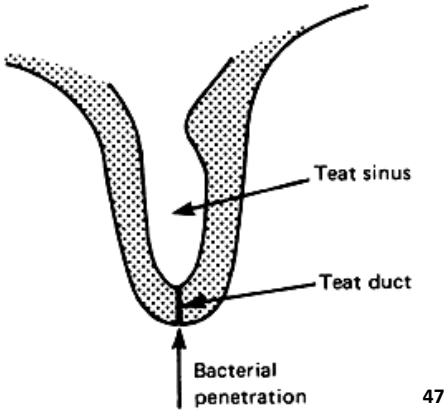
- ✓ Check or tick the information that they predicted correctly from **Question 1**.
- ❖ Star the information that they predicted incorrectly or did not consider from **Question 1**.
- o Circle any information that is confusing or that you need more clarification on.

5. Share the information that you circled. The trainer will clarify and explain this information again.

4.1 Key Facts

- **Animal hygiene:**
  - **Check udder pathology/diseases:**
    - Infections can occur due to many reasons.
    - After milking, the sphincter muscle in the teat is open and bacteria can enter easily.
  - **Mastitis:**
    - Inflammation of the udders caused by bacterial infection.
    - Effects: Reduces milk yields, increases the cost of production, and makes milk less valuable.
    - Signs/Symptoms: Difficult to recognise and diagnose. Increased body temperature, loss of appetite, death of animal.
    - Treatment: Cannot be completely eradicated/cured, but it can be reduced to low levels. Apply antibiotics to eliminate bacterial infection.
  - **Prevention:**
    - Wash udders to stimulate milk-let down; use a clean cloth or, if possible, disposable towels.
    - Dip teats in antiseptic dip after milking.

- Keep cow standing more one hour or more after milking. Provide fresh feed for cow to eat while standing.
- Keep records of milk production and health to track rapid changes and possible health concerns.



47

- **Material hygiene:**
  - **Milking machine:**
    - Some machines are turbulent and can cause milk to return to the teat with pathogens that cause infections.
    - Attach liners that do not slip during milking.
    - Liners should have “shields” or “non-return valves” to prevent milk from re-entering the teats.
    - Must be cleaned.
  - **Cans/containers:**
    - Pre-rinse the container soon after use.
    - Scrub the container with warm water and detergent or soap using a stiff bristled hand brush or scouring pad (e.g. “Superbrite”).
    - Rinse the container in running water.
    - Dip-rinse the container in boiling water for at least one minute and/or apply disinfectant.
    - Air-dry the milk container in the open.
  - **Space/room:**
    - Floor that is easy to clean and drain.
    - Good ventilation and lighting.
    - Facilities for manure disposal and washing cows.
    - Supply of clean water.
    - Must be cleaned regularly.
    - Remove old feed and supply fresh feed every day.

[47] Food and Agriculture Organization of the United Nations. (1989). *Milking, milk production hygiene and udder health: Mastits control*. https://www.fao.org/3/t0218e/T0218E00.htm#TOC

- **Milker hygiene:**
  - **Hands:** Wash hands with clean water and soap before handling milk. Hands should be free from cuts and sores.
  - **Clothes:** Wear clean over-clothes and gumboots while handling milk
  - **Health:** Milker should not have long nails, sneeze or cough, or smoke.[48]

- **Sick animals:**
  - Separate sick animals from healthy animals.
  - Clearly mark sick animals.
  - Milk last and discard infected milk.[49]

Guided Practice Activity

Topic 4.1 Task 3:

1. Separate into small groups (3-4 people) and read the following scenario. With your group, write a letter to Protais in response to his questions.

Protais recently began raising cattle for milk production. However, he is uneducated on animal health and hygiene matters. One of his cows died due to mastitis and he believes another one has the same infection. He needs your help and expertise.

Write Protais a letter responding to his questions:

a. How does mastitis infect the animals?

b. What are the signs of mastitis so that I can recognise it before another cow dies?

c. How do I treat mastitis?

d. What hygiene measures can I take to prevent mastitis and other infections from harming the animals? (Including: animal, materials, milker).

e. What should I do once I diagnose an animal with mastitis or another infection?

[48] SNV Netherlands Development Organisation. (2017, August). *Hygienic and quality milk production: Training package for dairy extension workers*. SNV World. https://snv.org/cms/sites/default/files/explore/download/hygienic_and_quality_milk_production_training_manual_and_guideline.pdf

[49] Dairy NZ. (n.d.). *Managing animal health*. https://www.dairynz.co.nz/milking/dairy-stockmanship/managing-animal-health/

2. Remember to use proper letter format ("Dear Protais,") and be supportive of Protais in his goal to raise cattle for milk production. At the same time, your letter should emphasize the importance of hygiene and animal health. Each group will present their letter to the rest of the class.

3. After all groups have written their letters, have a representative from your group read your letter out loud to the class. After each letter is read, give feedback and correct any errors in other groups' advice.

4. Give your letter to the trainer so that he/she review it after the session and provide feedback as needed.

Application Activity

Topic 4.1 Task 4:

1. Visit a local ruminant farm and greet the farmer and any other staff present.

2. Discuss with the farmer about hygiene and safety measures at the farm. Refer to the the questions below for guidance:
   a. Which milking materials do you clean?

   b. How often do you clean them? After every use? Daily? Weekly?

   c. What is the cleaning process for these materials?

   d. What precautions does the milker take before, during, and after milking?

   e. What can be done to prevent the spread of bacterial infections, such as mastitis?

3. After you have discussed with the farmer, watch closely as the farmer demonstrates how to properly milk a cow using proper hygiene measures.

4. Note your observations on the following points:
   a. Cleanliness of materials

   b. Hands and clothes of the milker

5. Thank the farmer for his/her time. After the visit, discuss as a class:
   a. What did you learn?

   b. What surprised you?

   c. Why is animal, material, and milker hygiene important?

Points to Remember

- Sources of milk contamination include udder infections, milking materials, the milker, feed and water, and the milking environment.
- Contamination of milk can be corrected through proper animal management, hygiene of milking equipment, milking practices, and personal hygiene of the milker.

Formative Assessment

After carefully reading the following items, answer the following questions individually:

1. Explain how udder diseases, such as mastitis, occur in ruminants.

2. What is the importance of record keeping in milk production and animal health?

3. Identify whether each statement is **true** or **false**:
   a. Some milking machines cause the milk to return to the teat, which can cause infections.

   b. Milking environments should be dark without windows.

   c. It is essential to keep sick animals in the same area as healthy animals to encourage their recovery.

   d. Milkers should wash their hands with clean water and soap as well as wear clean over-clothing before milking or handling milk.

Topic 4.2: Milking techniques

Key Competencies:

Knowledge	Skills	Attitudes
1. Identify milking methods	**1.** Select milking method	**1.** Decisive
2. Explain the importance of using a milking machine	**2.** Operate milking machine	**2.** Responsible
3. Explain the process of milking by hand	**3.** Perform milking by hand	**3.** Detail-oriented

Getting Started: What do we know and where are we going?

Topic 4.2 Task 1:

1. There are two milking methods: by hand and with a machine. Find a partner and brainstorm responses to the following questions:
   a. What are the advantages of milking by hand?

   b. What are the disadvantages of milking by hand?

   c. What are the advantages of milking with a machine?

   d. What are the disadvantages of milking with a machine?

2. After discussing, share your ideas with the class. Correct any major misconceptions or misunderstandings.

3. Review the Key Competencies table with the knowledge, skills, and attitudes you will gain by the end of this topic.

Problem Solving Activity

Topic 4.2 Task 2:

1. With a partner, discuss the following questions:
   a. What are the risks of milking by hand?

   b. What are the risks of milking using a machine?

   c. How can we promote animal health and safety while milking?

2. After discussing, take turns writing your responses to the questions on the board/flipchart.

3. Then, refer to **4.2 Key Facts** in their manuals. Read the information individually. While you read, do the following:
   - ✓ Check or tick the three methods of milking by hand.
   - ❖ Star the advantages of using a milking machine.
   - ○ Circle any information or terms that are unclear or confusing.

4. Share the information that you circled in **4.2 Key Facts.** The trainer will clarify and explain the information.

4.2 Key Facts

- **Milking**
  - Methods:
    - By hand
    - With a machine

- **Milking by hand:**
  - **Stripping method:**
    - Firmly seize the teat at its base between the thumb and fore finger and draw it down.
  - **Full hand method:**
    - Best method because it causes minimum injuries to the teats.
    - Circle teat with index finger and thumb at the junction of teat and udder, close the other portion of teat with remaining fingers and press on all sides against the palm.

- **Knuckling method:**
  - Press the thumb against the teats while the teats are in between thumb and fingers.
  - May cause injury to the teat.
  - Not advisable and least recommended.

- **Milking with a machine:**
  - Generally adopted for herds with large number of cows and with high yielders.
  - Milk flow is continuous.
  - **Advantages**: Reduced labour cost, short time for milking, less injury to teats, most hygienic method of milk production.
  - **Parts of a machine milking system**: milking unit, pulsator system, vacuum supply system, and milk flow system.
    - Milking unit is attached to the udder and has a teat-cup assembly, suspension cup, and connecting air and milk tubes.
    - The teat cup consists of a steel shell with a liner which fits over teats called as inflation.
    - The inflation squeezes and relaxes on the teat as the pulsator operates causing the milk to flow into the system
  - **Process**: The inflation squeezes and relaxes on the teat as the pulsator operates causing the milk to flow into the system.
  - **Hygiene**:
    - Disinfect the teat ends after milking by dipping them in antiseptic solution.
    - Immediately wash milk utensils and teat cups with warm water.[50]

Guided Practice Activity

Topic 4.2 Task 3:

1. Separate into small groups (3-4 people). First, re-read the three methods for milking by hand. With your group, practice imitating how to perform each method with your hands. Use classroom objects similar to udders, if possible.

2. Then, volunteer to come to the front of the room and demonstrate each method (stripping, full hand, and knuckling).

[50] Tamil Nadu Agricultural University (TNAU). (2008). *Methods of milking*. AgriTech TNAU. https://agritech.tnau.ac.in/ta/animal_husbandry/animhus_cattle_milking%20method.html

3. Next, work with your group to arrange the steps for using a milk machine into the correct order.

A. Clean the machine afterwards.	**B.** Grab the claw and hold it under the udder with the milk hose pointed to the front of the claw.	**C.** Move the cow so that it is standing in milking area with some feed.
D. Hook up the vacuum line to the vacuum port on the milker and turn on the vacuum pump.	**E.** Dip the teats into a 70% Iodine solution.	**F.** Move the bucket beside the cow.
G. Remove the cups when the milk going into the bucket slows to a stop.	**H.** Check the machine before use.	**I.** Turn off the machine and remove the lid from the bucket.
J. Attach all tubes and caps to the machine.	**K.** Check to see how and if the milk is flowing into the bucket.	**L.** Add the teat cups to the teats one at a time.
M. Clean the udder thoroughly.	**N.** Pour the milk into clean buckets or a milk container for storage and later use.	**O.** Store the machine in a warm dry place until next use.

1.	**2.**	**3.**
4.	**5.**	**6.**
7.	**8.**	**9.**
10.	**11.**	**12.**
13.	**14.**	**15.**

4. After you have attempted to order the steps, refer to **4.3 Key Facts**. Read the information with your group. As you read, confirm and correct your answers to the previous task.

5. Ask the trainer any questions you have about the information from **4.3 Key Facts**.

4.3 Key Facts

- **Using a milking machine:**

  Adapted from wikiHow's "How to Milk a Cow With a Milking Machine":

  1. "Check the machine before use.
  - Clean the machine daily or after every use.
  - Perform maintenance on the machine once a month or less to make sure parts are well oiled or greased, and any repairs that may need to be made are done before things get worse.
  - Disinfect the hoses, tank, and suction cups regularly (especially inside)
  - Cups should be covered or placed in a bag where they will not become contaminated or dirty during storage

  2. Attach all tubes and caps to the machine.
  - Make sure all tubes are connected properly.
  - Make sure the O-ring for the lid is properly in place before attaching the lid.
  - The lid should be sealed properly.

  3. Move the cow so that it is standing in milking area with some feed.

  4. Clean the udder thoroughly.
  - Use a clean rag or paper towels to clean the teats and lower part of the udder of dirt and debris.
  - Squeeze each teat in a downward motion to initiate milk let-down and to dislodge any plugs that may be accumulated at the end of each teat.
  - May not be necessary if the udder is already so full that the teats are leaking milk.
  - Discard the rag or towel.

  5. Dip the teats into a 70% Iodine solution.
  - Wait two minutes for the solution to dry.
  - Then, gently dab any excess iodine off from the end of the teat with a clean rag or paper towel.
  - Do not touch the teats afterwards.

  6. Hook up the vacuum line to the vacuum port on the milker and turn on the vacuum pump.
  - Remember to make sure all connections are secure and attached before turning anything on.

  7. Move the bucket or bucket-milker unit beside the cow next to her rib cage.
  - Provides room to access the cow's udder more easily.

  8. Grab the claw and hold it under the udder with the milk hose pointed to the front of the claw.
  - Open the vacuum to the claw and listen to make sure the pulsator is clicking properly.

  9. Add the teat cups to the teats one at a time.

10. Check to see how and if the milk is flowing into the bucket.
11. Remove the cups when the milk going into the bucket slows to a stop.
12. Turn off the machine and remove the lid from the bucket.
13. Pour the milk into clean buckets or a milk container for storage and later use.
14. Repeat for other cows.
15. Clean the machine afterwards.
16. Store the machine in a warm dry place until next use."[51]

Application Activity

Topic 4.2 Task 4:

1. You will visit a ruminant farm and assist a farmer with the milking process.

2. Before visiting the farm, watch videos of farmers milking ruminants by hand and with a machine. Pay close attention and ask questions because you will perform these same tasks soon.

3. Visit a local ruminant farm and greet the farmer and any other staff present.

4. Separate into small groups and rotate observing and paying close attention while the farmer demonstrates to milk a ruminant by hand. Identify which method the farmer uses.

5. After each group has observed the farmer, you will have the opportunity to assist the farmer as she/he milks the animal(s) by hand, if there is enough time. If there is not enough time for each trainee to assist, each group will select a representative to assist while the others observe.

6. Then, the farmer will demonstrate how to use the milking machine. If possible, assist with this process as well.

7. Finally, ask any questions you have about milking by hand and with a machine. Ask the farmer about her/his experience with both methods and which one she/he prefers.

[51] WikiHow. (2020, January 4). *How to milk a cow with a milking machine*. Retrieved 2020, from https://www.wikihow.com/Milk-a-Cow-With-a-Milking-Machine

Points to Remember

- Quality assurance begins at the farm.
- Good hygiene practice in milk production and handling is key to milk quality and safety.

Formative Assessment

After carefully reading the following items, answer the following questions individually:

1. Identify and explain the best method for milking by hand.

2. What are two advantages to milking with a machine?

1.

2.

3. Complete the following sentences:

a. You can disinfect teat ends after milking by dipping them in …….. solution.

b. Be sure to perform maintenance on the milking machine at least …….. per month to make sure the parts are working well and to make repairs as needed.

c. After using the milking machine, store it in a …….. …… place until the next use.

Topic 4.3: Milk storage and transportation

Key Competencies:

Knowledge	Skills	Attitudes
1. Describe milk storage conditions	**1.** Select and maintain milk storage material and equipment	**1.** Methodical
2. Identify milk storage materials and equipment	**2.** Store milk	**2.** Detail-oriented
3. Describe materials for milk transportation	**3.** Select material for milk transportation	**3.** Precise

Getting Started: What do we know and where are we going?

Topic 4.3 Task 1:

1. Discuss the following questions with a partner:
   a. Where do you buy milk from?

   b. Where is the milk kept in the store or shop?

   c. What are the conditions (temperature, organisation) of the milk storage area?

2. After discussing, share your answers and ideas with the rest of the class.

3. Review the Key Competencies table with the knowledge, skills, and attitudes you will gain by the end of this topic.

Problem Solving Activity

Topic 4.3 Task 2:

1. With your partner, brainstorm a list of all the materials and equipment you think are needed for milk transportation and storage.

Storage materials and equipment	Transportation materials and equipment

2. Using what you know about cleaning, discuss:

a. How should milk storage material and equipment be cleaned? What are the steps?

b. What is the importance of cleaning these materials and equipment?

3. After discussing, share your ideas with the rest of the class. Be sure to agree and disagree with each other and explain your reasoning.

4. Now, refer to **4.4 Key Facts**. Read the information out loud as a class. As you read, do the following:

- ✓ Check or tick the materials and equipment that you brainstormed correctly from **Question 1**.
- ✓ Check or tick the steps for cleaning that you brainstormed from **Question 2.**
- ❖ The importance of proper milk storage and transportation. Note: This will not be stated directly—you must use critical thinking to discover the importance.
- ○ Circle any information that is confusing or unclear.

5. Share the information that you circled with the trainer. The trainer will clarify and explain any confusing concepts.

4.4 Key Facts

- **Milk storage:**
  - Milk and milk products should be stored in:
    - Clean conditions.
    - Cool temperatures: About 4°C.
      - Dark, well-ventilated place.

- Storage should protect milk from:
  - Chemicals
  - Bacteria
  - Poor handling
- Keep separate and do not deliver:
  - Milk from a cow with mastitis.
  - Colostrum or any milk produced by a cow less than 5 days into the lactation period.
  - Milk of a cow treated with antibiotics. It is dangerous even for home consumption.
  - Milk taking in odours from surrounding substances, such as fuels, chemicals, or feeds.
- Best to deliver milk to a milk collection centre within 2 hours after finishing milking the first cow at the farm.
  - Reduces costs of cooling at home/farm.
  - Reduces exposure to bacteria.
- Material and equipment
  - Cans: To store milk inside.
  - Well: Can put milk cans in a well to keep them cool.
    - Make sure water in the well is not dirty.
    - Tighten tops of milk cans.
  - Cooling tank: Maintain milk temperature 3-5 ° C above water temperature.
    - Ice: Can be used in cooling tank.
    - Loosen tops of milk cans to let air escape, but make sure water does not mix with milk.
    - Cover cooling tank with a lid to protect from insects and dust.
  - Ice cones: Fill cones with crushed ice and place in the milk.

- **Cleaning milk storage material and equipment:**
  - Recover product residues by scraping, draining, and removing with water or compressed air.
  - Pre-rinse with water to remove loose dirt.
  - Clean with detergent
  - Rinse with clean water
  - Disinfect by heating or with chemical agents (optional).
    - If this step is included, the cycle ends with a final rinse, if the water quality is good.[52]

[52] SNV Netherlands Development Organisation. (2017, August). *Hygienic and quality milk production: Training package for dairy extension workers*. SNV World. https://snv.org/cms/sites/default/files/explore/download/hygienic_and_quality_milk_production_training_manual_and_guideline.pdf

- **Milk transportation material:**
  - Milk cans: Usually used by producers themselves or informal milk collectors.
    - Does not keep milk cool, so transportation distance must be short.
    - Advantage: Milk from different producers is not mixed, avoiding the risk of spoiling good milk with low-quality batches.
    - Aluminium and stainless steel are best.
    - Do not use plastic cans, buckets, or jerry cans.
  - Transportation method: Bicycle, animal, vehicle or foot.[53]

Guided Practice Activity

Topic 4.3 Task 3:

1. Separate into small groups. First, compare and contrast the traditional milk operations processes to the modern ones that have been explained in your manual. Discuss and write your ideas in the chart below.

Traditional	Both	Modern

2. Then, compare your group's ideas with another group. Discuss and debate the similarities and differences between the methods.

3. After the discussions, share your ideas with the class. Discuss as a class:
   a. What are the advantages of modern milk operations (milking, storage, and transportation)?

   b. What are the cultural challenges and expectations for milk operations?

4. Next, read the following scenario and discuss the questions that follow:

[53] Food and Agriculture Organization of the United Nations. (n.d.). *Small-scale dairy farming manual: Milk preservation*. https://www.fao.org/ag/againfo/resources/documents/Dairyman/Dairy/V1U4.htm

Celestine is new to dairy cattle farming. She has successfully milked her cows, but now she needs to store and transport it to the milk collection centre. Given your education in ruminant farming, she asks for your advice on the following points:

a. What are the proper conditions for milk storage?

b. Why is it important to properly store milk?

c. What should I do with milk that smells like the feeds?

d. When should I transport the milk to the milk collection centre? Why?

e. What materials do I need to transport the milk?

5. After discussing, share your group's answers to each question. Be sure to discuss and debate the responses.

6. Clarify the correct answers with the trainer.

Application Activity

Topic 4.3 Task 4:

1. Visit a nearby milk collection centre (MCC) and greet the staff.

2. Take a tour of the area and observe the following storage factors:
- **a.** Temperature
- **b.** Ventilation
- **c.** Cans/containers
- **d.** Cleanliness

3. Next, identify all of the storage and transportation material and equipment at the MCC. Are there any they should add to those listed in **4.4 Key Facts**?

4. Finally, ask the MCC staff the following questions as well as some of your own about milk storage and transportation. Note the responses in the chart below:

Questions	Answers
What are the challenges of storing milk?	
What are the challenges of transporting milk?	
Which materials and equipment are difficult to find/buy in this area?	
What is your advice for someone who is just beginning their career in dairy farming?	
Your question:	
Your question:	

5. Finally, assist the staff with milk storage, if possible.

6. After the visit, discuss as a class:
   a. What did you learn?
   b. What surprised you?

Points to Remember

- Never add milk of a cow with mastitis to cans for delivery to the MCC.
- Do not deliver colostrum or any milk produced by a cow less than 5 days in lactation.
- Never deliver milk of a cow treated with antibiotics because this milk is dangerous even for home consumption.
- Be aware of milk taking odour from surrounding substances, such as fuels, chemicals, and feeds.
- Filters used improperly are major sources of bacteria in milk.

Formative Assessment

After carefully reading the following items, answer the following questions individually:

1. Circle the types of milk that should NOT be delivered to the milk collection centre:
   a. Fresh milk.
   b. Milk from a cow with mastitis.
   c. Colostrum.
   d. Milk that has been stored in a cooling tank.
   e. Milk that smells like fuels.

2. Explain the cleaning process for milk storage material and equipment.

3. Complete the following sentences:
   a. If you decide to store your milk in a well, be sure the water in the well is not ……. and keep the tops of the milk cans ……

   b. It is best to deliver milk to the MCC within ……. hours of milking in order to reduce the costs of ……. at home and reduce exposure to ……

   c. Transporting in milk cans ensures that milk from different producers is not ……..

Self-Reflection

1. You have come to the end of the unit. You are going to do the survey you did at the beginning of the unit again to help you do self-assessment of your knowledge, skills, and attitudes.

Again, there are no right or wrong answers to this survey. It is for your own use to gauge your knowledge, skills and attitudes after the unit. Read the Knowledge, Skill or Attitude in the left column. Think about yourself: do you think you can do this? How well? Read the statements across the top. Put a check in column that best represents your situation.

My experience **Knowledge, skills, and attitudes**	**I don't have any experience doing this.**	**I know a little about this.**	**I have some experience doing this.**	**I have a lot of experience with this.**	**I am confident in my ability to do this.**
Ensure animal hygiene for milking					
Check udder pathology					
Clean materials					
Apply isolation measures for sick animals					
Diagnose udder pathology					
Choose milking methods					
Perform hand milking					
Use milking machine					
Select milk storage material and equipment					
Clean material and equipment for milk storage					
Identify cleaning materials					
Identify milk transportation material					
Perform milk storage					

2. Complete the table below by identifying areas from the unit where you have improved and where you need improvement with the actions/strategies you will use to help you improve when receiving and interpreting information at the workplace.

Areas of strength	Areas for improvement	Actions to be taken to improve
1. **2.**	**1.** **2.**	**1.** **2.**

REFERENCES

Afrane Okese, K. (2018, February 19). *Paddock grazing system: A solution to cattle production in Africa*. Agrihome. https://blog.agrihomegh.com/paddock-grazing-system/

Allice: Genetics & selection. (n.d.). *Good heat detection for organising insemination*. https://www.allice.fr/insemination-reproduction/insemination-on-farms/heat-detection.html

AnimalHandling101. (n.d.). *Restrain cattle*. Retrieved 2019, from https://animalhandling101.fandom.com/wiki/Restrain_cattle

Azizi, M. (2015, February 16). *Artificial insemination equipment*. LinkedIn SlideShare. https://www.slideshare.net/mohammadazizi4/artificial-insemination-equipment

CM Biology Notes. (2017). *Diagram showing the stomach and movement of food* [Diagram]. https://cmbiologynotes.wordpress.com/topics-covered/cellulose-digestion-in-ruminants/

Dairy NZ. (n.d.). *Managing animal health*. https://www.dairynz.co.nz/milking/dairy-stockmanship/managing-animal-health/

Economides, S. (1985). *Small ruminant production in the developing countries: Nutrition and management of sheep and goats*. Food and Agriculture Organization of the United Nations. https://www.fao.org/3/ah221e/AH221E05.htm

Eilts, B. E. (2012, September 25). *Pregnancy examination of the cow*. Louisiana State University Department of Veterinary Clinical Sciences. https://therio.vetmed.lsu.edu/bovine_pregnancy.htm

Food and Agriculture Organization of the United Nations (FAO), & Informartion Network on Post-Harvest Operations (INPhO). (1998). *Farm structures in tropical climates: Animal environmental*

requirements. https://www.fao.org/3/s1250e/S1250E10.htm#Animal%20environmental%20requirements

Food and Agriculture Organization of the United Nations (FAO), & Informartion Network on Post-Harvest Operations (INPhO). (1998). *Farm structures in tropical climates: Cattle housing*. https://www.fao.org/3/s1250e/S1250E11.htm

Food and Agriculture Organization of the United Nations, & Informartion Network on Post-Harvest Operations (INPhO). (1998). *Farm structures in tropical climates: Sheep and goat housing*. https://www.fao.org/3/s1250e/S1250E17.htm#Sheep%20and%20goat%20housing

Food and Agriculture Organization of the United Nations. (1989). *Milking, milk production hygiene and udder health: Mastits control*. https://www.fao.org/3/t0218e/T0218E00.htm#TOC

Food and Agriculture Organization of the United Nations. (1994). *A manual for the primary animal health care worker: Unit 19: Calving (parturition)*. https://www.fao.org/3/t0690e/t0690e05.htm#unit%2019:%20calving%20(parturition)

Food and Agriculture Organization of the United Nations. (1994). *A manual for the primary animal health care worker: Unit 20: Lambing and kidding (parturition)*. https://www.fao.org/3/t0690e/t0690e05.htm#unit%2020:%20lambing%20and%20kidding%20(parturition)

Food and Agriculture Organization of the United Nations. (1994). *A manual for the primary animal health care worker: Unit 18: Pregnancy in ruminants*. https://www.fao.org/3/t0690e/t0690e05.htm#unit%2018:%20pregnancy%20in%20ruminants

Food and Agriculture Organization of the United Nations. (1994). *A manual for the primary animal health care worker: Unit 21: Care of the*

newborn. https://www.fao.org/3/t0690e/t0690e05.htm#unit%2021:%20care%20of%20the%20newborn

Food and Agriculture Organization of the United Nations. (n.d.). *After the calf is born*. https://www.fao.org/ag/againfo/themes/documents/pub6/p604.htm

Food and Agriculture Organization of the United Nations. (n.d.). *Feed quality*. https://www.fao.org/ag/againfo/themes/documents/PUB6/P618.htm

Food and Agriculture Organization of the United Nations. (n.d.). *Small-scale dairy farming manual: Milk preservation*. https://www.fao.org/ag/againfo/resources/documents/Dairyman/Dairy/V1U4.htm

Genomia. (n.d.). *Instructions for animal sampling*. https://www.genomia.cz/en/pokyny/

Graves, W., & Dyer, T. G. (2017, March 28). *Estrous synchronization for beef cattle*. UGA Cooperative Extension. https://extension.uga.edu/publications/detail.html?number=B1232&title=Estrous%20Synchronization%20for%20Beef%20Cattle

Hall, J. B., Liles, A., & Whittier, W. D. (2009, May 1). *Estrus synchronization for heifers*. Virginia Tech Publications and Educational Resources. https://www.pubs.ext.vt.edu/400/400-302/400-302.html

Holmström, L. (2013). *Fodder to ruminants within agroforestry systems in Rwanda: Species and management*. Swedish University of Agricultural Sciences. https://stud.epsilon.slu.se/5790/1/holmstrom_l_130628.pdf

Holstein Foundation. (2017, November). *Milking and lactation*. https://www.holsteinfoundation.org/pdf_doc/workbooks/Milking_Lactation_Workbook.pdf

Infonet Biovision. (2019, October 2). *Animal nutrition and feed rations*. https://www.infonet-biovision.org/AnimalHealth/Animal-nutrition-and-feed-rations

Infovets. (n.d.). *Reproduction management: Artificial insemination*. https://infovets.com/healthycowinfo/A716.htm

Instructional Materials Service Texas A&M University. (2002). *Pregnancy diagnosis (palpation)*. https://www.birdvilleschools.net/cms/lib/TX01000797/Centricity/Domain/1390/Pregnancy%20and%20Palpation%20Lesson.pdf

International Livestock Research Institute, German Cooperation, & Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). (n.d.). *How to conserve fodder*. https://cgspace.cgiar.org/rest/bitstreams/187186/retrieve

Jayasuriya, M. C. (n.d.). *Principles of ration formulation for ruminants*. International Atomic Energy Agency. https://inis.iaea.org/collection/NCLCollectionStore/_Public/33/032/33032967.pdf?r=1&r=1

Kelley, A. (2016, June 2). *The best way to clean water troughs*. Hobby Farms. https://www.hobbyfarms.com/the-best-way-to-clean-water-troughs/

Luginbuhl, J. M. (2015, September 21). *Breeds and production traits of meat goats*. NC State Extension Publications. https://content.ces.ncsu.edu/breeds-and-production-traits-of-meat-goats

Mondal, P. (n.d.). *FIG 24.1. Observations to be made are given in Table 24.1* [Figure]. Your Article Library. http://www.yourarticlelibrary.com/dairy-farm-management/pregnancy-diagnosis-of-animals-importance-methods-and-procedures/35867

New Mexico State University. (n.d.). *Improving economically important traits*. College of Agricultural, Consumer and Environmental Sciences. https://aces.nmsu.edu/sheep/selection_breeding/improving.html

O'Connor, M. (2016, May 17). *Heat detection and timing of insemination for cattle*. Penn State Extension. https://extension.psu.edu/heat-detection-and-timing-of-insemination-for-cattle#section-39

Oltjen, J. W., & Beckett, J. L. (1996, June). *Role of ruminant livestock in sustainable agricultural systems*. PubMed. https://pubmed.ncbi.nlm.nih.gov/8791215/

Ontario SPCA and Humane Society. (n.d.). *Cleaning*. https://ontariospca.ca/spca-professional/shelter-health-pro/infection-disease-control/cleaning-disinfection/cleaning/

Penn State Animal Resource Program. (2015, July 14). *Instrument preparation and sterilization*. Penn State Research. https://www.research.psu.edu/arp/surgery/instrument-preparation-and-sterilization.html

Proctor, A. (2019, August 27). *The great transition: Turning calves into functioning ruminants*. Form-A-Feed. https://formafeed.com/the-great-transition-turning-calves-into-functioning-ruminants/

Rwanda Education Board. (n.d.). *Unit 4: Fodder*. REB e-Learning Platform. https://elearning.reb.rw/course/view.php?id=275§ion=4

Schoenian, S. (2019, October 12). *Docking and castrating*. Sheep 101. https://www.sheep101.info/201/dockcastrate.html

Sheep milk production: Milking sheep. (n.d.). Milking Sheep. https://www.milkingsheep.com/sheep-milk-production

Shoenian, S. (2019, October 20). *Breed selection*. Sheep 101. https://www.sheep101.info/201/breedselection.htm

Short, W. (2018, May 20). *8-step guide to artificially inseminating a dairy cow*. Farmers Weekly. https://www.fwi.co.uk/livestock/livestock-breeding/8-step-guide-artificially-inseminating-dairy-cow

Snohomish Conservation District. (2016, March 22). *The how and when of pasture renovation*. https://snohomishcd.org/blog/2016/3/22/xxwep7sr64iijnmie89veam3c9y6it

SNV Netherlands Development Organisation. (2017, August). *Hygienic and quality milk production: Training package for dairy extension workers*. SNV World. https://snv.org/cms/sites/default/files/explore/download/hygienic_and_quality_milk_production_training_manual_and_guideline.pdf

Tamil Nadu Agricultural University (TNAU). (2008). *Methods of milking*. AgriTech TNAU. https://agritech.tnau.ac.in/ta/animal_husbandry/animhus_cattle_milking%20method.html

Tamil Nadu Agricultural University. (n.d.). *Artificial insemination*. TNAU Animal Husbandry. https://www.agritech.tnau.ac.in/animal_husbandry/animhus_cattle_AI.html

Tamil Nadu Agricultural University. (n.d.). *Breeding management of sheep and goat: Introduction*. TNAU AgriTech. https://agritech.tnau.ac.in/expert_system/sheepgoat/Breeding%20Management%20of%20Sheep%20and%20Goat.html

Terrill, C. E. (1986). *Small ruminant production in the developing countries: Introduction*. Food and Agriculture Organization of the United Nations. https://www.fao.org/3/ah221e/AH221E06.htm#ch6

Turner, J. L. (n.d.). *Figure 1. Diagram of the reproductive tract of the cow. (Adapted from Rich and Turman, n.d.)* [Figure]. New Mexico State University College of Agricultural, Consumer and Environmental Sciences. https://aces.nmsu.edu/pubs/_b/B212/welcome.html

User: Alpha WebAPPt. (2019, April 1). *Cleaning and disinfection generally consists of six steps*. Hygiene Plus. https://hygieneplusuae.com/2019/04/01/cleaning-and-disinfection-generally-consists-of-six-steps/

Vikaspedia. (n.d.). *Feeding management*. https://vikaspedia.in/agriculture/livestock/sheep-and-goat-farming/feeding-management

Washington Animal Disease Diagnostic Laboratory. (2019, June). *Pregnancy testing in ruminants*. https://waddl.vetmed.wsu.edu/animal-disease-faq/pregnancy-testing-in-ruminants

WikiHow. (2020, January 4). *How to milk a cow with a milking machine*. Retrieved 2020, from https://www.wikihow.com/Milk-a-Cow-With-a-Milking-Machine

This publication is made possible by the support of the American People through the United States Agency for International Development (USAID). The contents of this are the sole responsibility of Education Development Center (EDC) and do not necessarily reflect the views of USAID or the United States Government.

RWANDA POLYTECHNIC – RP

P. O. BOX 164 Kigali Rwanda

info@RP.gov.rw

www.RP.gov.rw