AGRICULTURE

TEACHERS' GUIDE
GRADE 11

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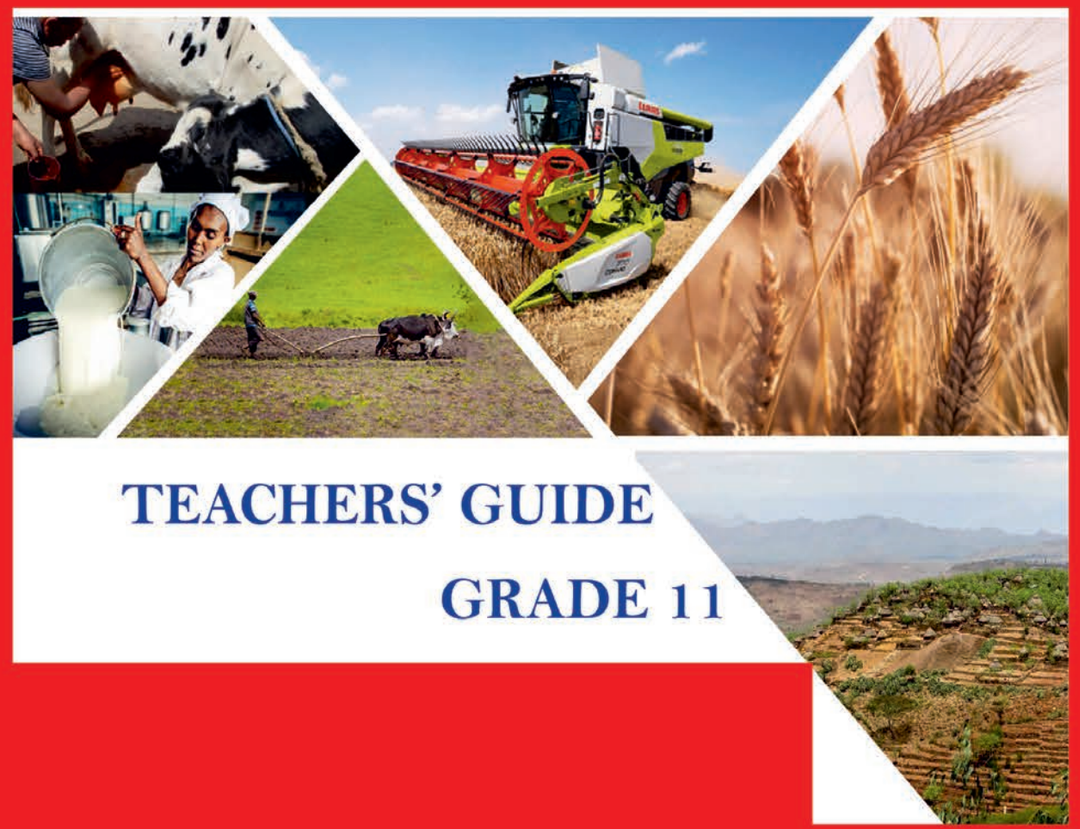

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Writers:

Seid Ali (MSc)

Shimelis Gizachew (PhD)

Editors:

Bimrew Asmare (PhD) (Content Editor)

Fetene Regassa (PhD) (Curriculum and Instruction Editor)

Tamene Kitila (PhD) (Language Editor)

Illustrator

Yonas Azene (MSc)

Designer:

Ephrem Alamrew (MSc)

Reviewers:

Taye Tolemariam (Professor, PhD)

Teramage Tesfaye (PhD)

Evaluators:

Daniel Taddesse (PhD)

Serawit Handiso (PhD)

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Foreword

Agricultural education teaches students about agriculture, food and natural resources from topics which are already set in the syllabus. The Student Textbook and Teachers' Guide for Grade 11 Agriculture are aligned with the new curriculum and classroom realities. This Teacher's Guide in particular has been produced in order to help you, the teacher of grade 11 agriculture, in interpreting the new curriculum syllabus to satisfy its objective of producing learners with the requisite agricultural skills. It aims at helping you as a teacher to have a clear line in what you teach and how you teach it by giving you a course scenario for the entire school-year. You should stimulate in students the responsibility to care for the local and global environment and to adopt sustainable agricultural systems. Students are expected to develop a wide variety of skills, including problem solving, critical thinking, decision-making, communication, cooperation, digital literacy, and enterprise development, as well as a positive attitude to the real world.

Studying agriculture prepares students for entrepreneur and employment, both by developing important agricultural skills and as a preparation for careers that require knowledge of the subject such as feed processing, dairy cattle production and industrial crops production. Teachers are urged to read this guide carefully and to support their students by putting into action the instructional methods and activities suggested in it. The guide includes possible answers for all activities and review questions in the Student Textbook, but these answers should not bar the students from looking for alterative answers.

It is worthwhile to mention that our aim is to provide the teacher with suggestions, not instructions. We are sure that each teacher can use his or her discretion in teaching this subject. The writers feel that there is room for producing an even more adequate Student Textbook and Teacher's Guide for Grade 11 Agriculture by using feedback from its users and by including additional topic-specific instructional methods and illustrations.

Introduction To The Teacher's Gude

Agriculture is the back bone of the Ethiopian economy. It includes crop production and animal rearing as well as the wise use of natural resources. This particular sector determines the growth of all other sectors and consequently the whole national economy. Today, agriculture constitutes over 40% of the gross domestic product (GDP), and earns over 90% of the foreign exchange. Agricultural activities also create employment or job opportunities for the largest segment of the population. To be precise, agriculture contributes over 80% of all employment in the country. Agriculture is an interdisciplinary science suited to students who are interested in the application of science in a real-world context. Agricultural education introduces students to many aspects of agriculture, food, and natural resources. At this grade level, agriculture teaching incorporates classroom, field practices, observations and simple experiments. Field activities/ works could be practiced in line with school backyard agricultural activities.

The Grade 11 Agriculture Student Textbook has been designed to cover five thematic areas that can be applied to Ethiopian context. These are **crop production and management** (introduction to crop production and management, field crop production and management and industrial crop production and management), **animal production and management** (introduction to farm animal species, feeding and nutrition, breeding, housing, health care of farm animals and specifically dairy cattle production and management), **natural resources** (management of natural resources, concepts of biodiversity, and climate change adaptation and mitigation), **agricultural technology** (mechanized farming), and **nutrition-sensitive agriculture** (introduction to human nutrition such as food and nutrition security, malnutrition, and diversified food production and consumption).

The student textbook comprises 16 units. The Student Textbook was written to cover all possible angles on the topic, supported with relevant illustrations. The sections include activities which partly involve field work. The nature of agriculture subject is somewhat different from other parallel subjects set at this grade level. This is especially true since agriculture

education demands practical activities both under indoor and outdoor conditions. Within this scenario, a wide range of field work activities are formulated/designed in the student's textbook. Field activities most often involve observations and interview. Students are required to visit (among others) the nearby farms, farmers, market places, agricultural offices, veterinary clinics and processing factories, depending on the nature of tasks and resources available in their school. Therefore, students (individually or in small groups) should complete the suggested farming activities and should come back with relevant reports to be shared with the whole class. The field work provides the opportunity for students to improve by testing the application of their knowledge and skills in the real world context outside the school system. It also stimulates students to learn from the local context, for example, the role of indigenous knowledge in agricultural production.

General Aims of Agriculture Education

Agricultural science aims to develop students':

- interest in agricultural science and their appreciation of how interdisciplinary knowledge can be used to understand contemporary issues in food and non-food production
- understanding and appreciation of agriculture as a complex and innovative system, and how it relates to sustainable production of food and non-food products
- understanding that agricultural science knowledge is used in a variety of contexts and is influenced by social, economic, cultural and ethical considerations
- ability to conduct a variety of field, research and laboratory investigations involving collection and analysis of qualitative and quantitative data, and interpretation of evidence
- ability to critically evaluate agricultural science concepts, interpretations, claims and conclusions, with reference to evidence

- ability to communicate understandings and justify findings and conclusions related to agricultural production systems, using appropriate representations, modes and genres.

Structure of the Teacher's Guide

The Student Textbook of Grade 11 Agriculture comprises of 16 units. This Teachers' Guide is structured unit-by-unit in line with the text book. It is believed that this book practically guides the teacher in the teaching and learning of all topics covered in the syllabus. Each topic in this teacher's guide contains the following sections.

Periods Allotted: A total 89 periods (45 minutes each) are already set in the curriculum syllabus for teaching this grade level. Thus, periods allotted for each unit are provided with overall assumption of teaching grade 11 agriculture over the entire school year, at least three periods per week. Please note that the number of hours to be used for each topic or each week may vary from school to school.

Learning Competencies: Each unit of study has specific learning competencies, and these are listed at the beginning of each unit in both the Student Textbook and the Teacher's Guide. They provide a useful checklist for both students and teachers. Most importantly, the learning competencies in each unit are the focal point of the entire teaching-learning process.

Contents: The topics and sub topics of the unit are listed down for easy reference.

Overview: This section is a brief introduction summarizing what has to be covered in the unit. In other words, it is a general or comprehensive outline of the unit.

Teaching Learning Process: This is the most important part of the guide. It presents the lesson's core activity, including instructions for setting up and presenting each lesson topic and every activity, in sequence. It has sub-sections such as:

- **Suggested instructional materials:** These are materials needed for specific instructional process such as laboratories, farms, pictures, YouTube videos and ICT facilities. They include resources for students with special needs..
- **Suggested teaching methods**: In this part of the teaching learning process different strategies for approaching the topic are suggested. Teaching methods may vary depending on the nature of students, the topic and activities. Several methods of teaching are described in the teaching methods section.
- **Pre-lesson preparation:** Please know that teaching is a three-phase activity: preparation, delivery and assessment. As a reflective teacher, you should give more time and thought to planning and preparation of your sessions and select the most appropriate active learning methods for the topic to be covered before coming to the classroom. It involves planning for lesson, selecting appropriate methods, materials, classroom activities, and assessments and organization in advance.
- **Lesson presentation:** This suggests how the lesson is presented to the class as a whole. Usually this task is performed by the teacher, but can be performed by students or guest speakers. At the end of each class, try to summarize the main points of the lesson.
- **Assessment and follow-up:** Assessment Assessment is part of the teaching-learning process which helps you identify whether students have fully understood the material. Quite a lot of objectives are contained in the syllabus and minimum learning competence documents (included at the back of this Teacher's Guide) that students are expected to achieve during the year. It is very important to meet the requirements of the syllabus, and assess how far students have achieved the objectives set at the start of a unit. Different kinds of assessment activities are included in this course. Some, like the review exercise questions, ask students to recall previously learned information, while others, like boxed activities focus on processes such as analysis, constructing or demonstrating skills. Possible approaches to assessment are to carry out continuous assessment in the course of ordinary classroom teaching and to conduct regular testing or exam-setting. Whatever the approach chosen, the teacher of agriculture should assess all aspects

of knowledge and understanding (what students know of the subject matter) and underpinning skills (what students can do).

Assessment helps to improve your teaching and facilitate students' learning. Through assessment you will be able to identify misconceptions and intervene immediately. When you conduct assessment, it is important to consider what you will do with the information and why. You should give particular attention to continuous assessment, self-assessment and peer assessment. A wide range of assessment tools could be used, including direct observation, quizzes, tests, homework, report, presentations, and mid/final examinations.

- **Answers for activities, additional questions and review exercise:** The Student Textbook follows an activity based approach. Activities are found in each section. Answers (or suggested approach) for each activity is provided in this Teacher's Guide in each section. Review exercises are given at the end of each unit in the textbook. The answers to review questions are given at the end of each unit of the Teacher's Guide. Students performing below the minimum learning competencies should be monitored against the required competencies. Fast-learner students should answer all questions. If fast-learner students complete their class work earlier than the slow-learner students, please give them some challenging questions so that they do not remain idle and get frustrated. Such types of questions in this teacher's guide are called 'Additional questions'. Their answers are also provided in each section. It is worthwhile to mention that these answers (for activities, additional and review questions) should not bar the students from looking for alterative answers. What is required is that the students are able to come up with, and explain knowledgeably, their own answers to the questions.

Suggested Teaching Methods

There are many different ways of teaching agriculture. In this Teacher's Guide, a range of active-learning methods are suggested for each section. However, it may be necessary to vary the suggested methods from one school to another depending on factors such as funding, laboratory

facilities, availability of the suggested instructional materials and time available for teaching, in addition to teacher's preferences. Since no two people interpret the same information in the same way, no two people end up with the same understanding of the concepts and facts being studied. A governing rule in this regard is that a teacher should employ at least two methods of teaching for each topic to suit different learning needs. Some teaching methods are identified and elaborated below.

Brainstorming: This is is a method of generating ideas and sharing knowledge to solve a particular topic. Brainstorming is a group activity where each participant shares their ideas as soon as they come to mind. It is very useful for gauging how much students know, recognizing how many links between topic areas they have made and picking up misconceptions that the students may have. Entertaining brainstorming questions enable the teacher to assess students' abilities and their prior knowledge about the topic. It also helps the teacher decide how to approach and present the topic to the students. For this reason this technique is widely utilized in the students' textbook for beginning a session.

Questioning and answering: The teacher asks questions during lectures keep students alert and attentive. Students should also be encouraged to ask questions. It is useful for beginning and ending a lesson.

Gapped lecture: In this method, very crucial content is delivered to the class by the teacher. The method has a particular importance when the number of students is very large. It is useful for beginning and ending a lesson. Since lecture is one-way communication, however, the engagement of students is minimum in this method.

Discussion (small group, buzz group, panel): This method involves sharing of ideas or concepts between students and the teacher. Students work together to achieve shared objectives. Their responsibilities are to maximize their own learning and that of others in the group. The teacher needs to assign students to a learning group and will sometimes give students specific roles to undertake in the group. In almost all units, there are activities especially prepared for discussion. The activities include

challenging and argumentative questions so that students can learn more from the discussion and understand ideas and concepts easily. If everyone participates actively, discussion allows sharing of each other's ideas. It may not be suitable for large classes and can also be time consuming.

Practical activities: Students may undertake practical work individually or in groups. It allows students to get hands-on experience. Practical activities may be undertaken in indoor conditions such as in a laboratory or outdoors such as field work. Students develop a wide range of skills such as identification, observation, collecting, measurement, manipulation, data recording, investigation, making predictions, interpretation, evaluation, synthesis, drawing conclusions, report writing and presentation. Students develop desirable qualities such as self-confidence, curiosity, interest and cooperation. This method is highly recommended and should be used as much as possible. It is our utmost hope that schools will be rearranged in such a way that provide students the necessary resources and backyard gardens to perform practical activities such as silage making and milk processing.

Field work: Field work is an outdoor learning activity in which students develop skills such as identification, observation, collecting, measurement, data manipulation, recording, analysis, report writing and verbal reporting. It is most often accomplished through observations and interview. Field observation enables students to associate what they have learnt theoretically in the class with the actual physical features in the field. This technique encourages students to appreciate the actual environment. The field observation should be pre-planned and purposeful. Students should be given clear instructions on how to collect, organize, analyze and interpret data. Each group is expected to write a report and present its findings to the whole class.

Demonstration: AA demonstration is the process of teaching how to make or do something by showing it being done as a step-by-step process. This strategy improves the understanding of complex skills and principles. Students can follow along with the learning process. Knowledge becomes permanent because this method utilizes different human senses. Students

are motivated to study and gain necessary skills.

Presentation (group or independent): This method is most often used in association with group work and field visit activities. This is one way of increasing students' engagement in class room. Giving presentations will help students gain confidence, self-esteem, and autonomy while they are working independently, or as a small group. Presentation skills help create innovative ideas when students come up with creative and interesting notes or slides to illustrate their talk. The use of presentation aids makes for a much more interesting talk, and the creation of such aids can help develop students' confidence and leadership skills.

Audiovisual techniques and/or digital learning: This teaching method is used to communicate an idea with the aid of visuals such as flip charts, posters, PowerPoint, etc. The teacher should bring real objects, models, pictures, video, cartoons, audio, phones, television, etc. to the class. When you teach the alimentary canal of ruminant and monogastric animals, for example, you can use cartoons from each category of animal.

Think-Pair-Share: This is a collaborative learning strategy in which students work together to solve a problem or answer a question about an assigned reading. This technique requires students to think individually about a topic or answer to a question; and share ideas with classmates. This strategy fosters student ownership of learning and promotes participation at a higher level.

Problem solving: This is called problem-based instruction. In a problem solving method, students learn by working on problems. This enables the students to learn new knowledge by facing the problems to be solved. The students are expected to observe, understand, analyze, interpret, find solutions, and perform applications that lead to a holistic understanding of the concept. In this Teachers' Guide the technique is employed occasionally, for example, when balancing a ration using the Pearson square method of ration formulation.

Guest speaker: Inviting a guest speaker to the classroom gives students the occasion to engage in a discussion; it is a model of citizenship in

action. Guest speakers make lessons interactive. Students are able to ask questions and receive answers that may not be available in a textbook or on a video. Adding a guest speaker is a productive way to help students get a clear understanding of the points the teacher is trying to highlight. This method of teaching is suggested in this teacher's guide, for example, for the topic of climate change (Unit 13), farm mechanization (Unit 14) and Human nutrition (Unit 15-16). Guest speakers in Agriculture course could also be managers /owners of modern crop/animal farms and industries, as they could share their hands-on experience and inspire students to have their own farms in the future.

General Information for the Teacher

This Teachers' Guide is designed to assist teachers of Agriculture in Grade 11 in planning, organizing, delivery of the contents and activities, and student assessment. The General Education Curriculum Framework requires the employment of participatory teaching and learning approaches in which learners are at the center of the process. Accordingly, the Students' Textbook and this Teachers' Guide are based on student-centered learning approach following active teaching-learning methodology as a strategy. You are required to use student-centered approach and active leaning strategies to facilitate student-empowered learning through active participation expressed in terms of students' performing activities, answering questions, seeing and reflection, presentation, experience sharing, group work, etc. This encourages students to have more responsibility for their learning. The student-centered approach and active learning strategies also stimulate and motivate teachers as they foster interest and enjoyment, and enhances professional development. The role of a teacher is to inspire, motivate, encourage and educate students. Students can be of any age and from any background.

Organizing and Managing Group Work

Organizing groups and managing group work for specific teaching-learning activity is important role of a teacher. The following ideas may help you to formulate effective working groups. Groups of small size are preferred.

The number of students in each group should not be more than seven. You may organize the groups by mixing fast-learners with medium-learners and slow-learners. Remember that in any class there may be a wide range of abilities or needs, and by using group work, as a teacher, you can ensure that all students have the opportunity to succeed in learning. With regard to this, make sure to consider those students with special learning needs (i.e., students with disability). Empowerment is constructed by the joint activities of the teacher and the students.

After organizing students into groups for a particular topic, you should give clear instructions and explain how you want them to work together. You may assign different group responsibility to each member of the group (e.g., leader, facilitator, note-taker/secretary, time keeper, observer, reporter/ presenter, etc.). Students are expected to interact, share ideas and ask their peers first if they need help. The group leader manages the group discussion while the secretary writes minutes and records the opinions of the students. They are all responsible for the outcomes, which are evaluated against agreed criteria.

To enable successful group work, a facilitator needs to explain the purpose of discussion clearly, assure group members that their ideas are valued, listen to and build on contributions of group members, prevent individuals from dominating the discussion, summarize the discussion at the end, ensure that all group members feel part of the activity and introduce activities or questions to stimulate discussion.

Giving Notes

In principle, teachers are not expected to give notes on the black/ whiteboard. However, the teacher may give summary notes which give general views about the topic that has been taught at the end of each unit or sub-unit. Sometimes some topics notes appear only in the teacher's guide but not in the book to reduce bulkiness, for example, table showing key terminologies for various classes of farm animals in Unit 4. Such types of notes should also be provided to students, if necessary. Otherwise, the teacher is not obliged to write every detail that is depicted in the textbook.

The teacher should teach the students to how to take notes from their textbook and other reference materials.

Feedback

Most of the field and group work activities are presentation- and report-based when formulated. Students should work independently or in small groups and should be encouraged to share the summary of their work or findings to the whole class and should report to you as well. It is very important for you, the teacher of agriculture, to provide them with timely and constructive feedback. It is believed that students should be encouraged, appreciated and recognized by their teacher when they try to answer questions and participate in discussions. You are strongly advised to make your feedback in sandwich form. This means you should start your feedback from the positive followed by any weaknesses that need improvements and finally close it with appreciation (positive-negative-positive). This reinforces learning at the highest level.

General Objectives of Grade 11 Agriculture Subject

1. **To develop understanding of and acquire knowledge of:**
   - agriculture and evolution of modern agriculture
   - origin of domesticated crops, classification of crops plants and major factors affecting crop production
   - field crops, their growth and management requirements, production constraints
   - major industrial crops in Ethiopia, their uses, growth and management requirements and production constraints
   - farm animal species and understand their production and importance, factors affecting their production in Ethiopia
   - animal feeds and feeding practices, feed sources and classification, and feed nutrient requirements
   - principles of farm animal breeding and reproductive methods
   - types of animal shelter and houses so as to judge its quality
   - animal health and disease control
   - dairy cattle production and management

- major natural resources, their benefits, degradation and management
- concepts of biodiversity, biodiversity threats and conservation
- climate change, climate variability, climate mitigation and adaptation
- human nutrition and nutrition sensitive agriculture and
- mechanized farming.

2. **To develop skills and abilities of:**
   - applying the scientific method to solve agricultural productivity problems
   - demonstrate the skills of preparing and conserving typical animal feeds
   - conducting simple field surveys and writing report and presentation of results
   - conducting literature search and gathering information on agriculture related topics
   - assessing agricultural production systems through observation, classification, comparisons, communication, measurements, questioning, drawing conclusions, applying concepts and relating cause and effect
   - coming up with solutions to agricultural problems through critical assessment of production systems.
3. **To develop the habit and attitude of:**
   - willingness to participate in community-based initiatives involving improvement of agricultural productivity, natural resource management, biodiversity conservation and climate change adaptation and mitigation
   - develop motivation to participate in agricultural activities, apply good management practices for successful agricultural farming and thereby, increase agricultural production and profitability
   - curiosity, love, freedom, honesty, respect, co-operation, tolerance, humility, patriotism, reasoning, and openness as values of learning agriculture as a science.

Unit 1 Introduction to Crop Production

Periods allotted: 8 periods

Unit Introduction

In this unit, the students will learn the basic principles of crop production including, the origins of domesticated crops, classification of crops, status of crop production in Ethiopia, and the role of indigenous knowledge in crop production.

Learning Outcomes

At the end of this unit, students will be able to:

- define crop production related terms/phrases
- explain origin of different domesticated crops
- describe the status of crop production
- classify crop plants
- analyze different cropping systems and principles of crop husbandry
- explain indigenous knowledge used related to crop production

1.1 Definition of terms in crop production

Period allotted: 1 period

Learning Competencies

At the end of this lesson, students will be able to:

- define common terms used in relation to crop production
  describe the evolution of agricultural practices

Contents

- Definition of some common terms in crop production
- Evolution of agriculture

Overview

Agriculture is the deliberate cultivation of crops and rearing of animals.

Shifting cultivation: is a form of agriculture in which an area of ground is cleared of vegetation and cultivated for a few years and then abandoned for a new area.

Settled agriculture: the practice of using the same plot of land continuously over a long period to grow crops or rear livestock.

Subsistence farming: the practice of growing crops and raising livestock sufficient only for one's own use, without any surplus for trade.

Teaching-Learning Process

Suggested instructional materials

- Pictures of hunter-gatherers
- Pictures/figures showing shifting cultivation
- Pictures/figures of crop cultivation

Suggested Teaching Methods

- Brainstorming
- Questions and answers

- Explanation

Pre-Lesson Preparation

Before starting the lesson, gather the instructional materials required.

The school pedagogical center, internet or the school library may have relevant pictures/figures.

Presentation of the Lesson

a) Introduction to the lesson

One way to introduce this topic could be by first introducing yourself, as this is the first day and the first-class for you. This can be followed by introducing the objectives of the lesson. This helps the students to know why they are learning the topic. Ask relevant questions to motivate and make them curious about the topic. Questions like the following may help:

- What is agriculture?
- How do you think agriculture started originally?
- What human activities are grouped under agriculture according to your experience?
- What is the difference between agriculture and farming?

b) Body of the lesson

Start by explaining how societies survived before the start of conventional agriculture. Follow this up with the transformation from a hunter-gatherer lifestyle to a shifting cultivation as a way of producing food. Provide a clear definition of settled agriculture and subsistence farming. Subsistence farming is a form of settled agriculture. Ask questions about the difference between hunter-gatherers and the societies that practice shifting cultivation. You can also ask students to explain how these differ from settled agriculture.

Answers

Societies that practiced hunter gatherer life style are always on the move in search of food both through gathering edible wild plants and hunting. Similarly, in shifting cultivation people clear the forest, cultivate it for 1

or 2 seasons and then move to a new area and repeat the practice. On the contrary, in settled agriculture, societies cultivate the land and produce food on a permanent basis and agriculture is relatively more intensive (soil cultivation, manure addition, weed control and other practices are common)

c) Stabilization

Give a summary of the following points.

- agriculture, shifting cultivation and settled agriculture
- the shift from hunter-gatherer lifestyle ➔ to shifting cultivation ➔ and then, to settled agriculture

Assessment and Follow-Up

a) Assessment

At the end of the lesson, make sure your students have understood the basic concepts of the lesson and achieved the objectives. Check this by asking them questions as classwork such as:

- What is agriculture?
- What is shifting cultivation?
- What is the difference between hunter-gatherer lifestyle and settled agriculture? Shifting cultivation and settled agriculture?

b) Follow up

Check the students' understanding of the lesson by giving them an exercise to do independently.

- Write the meaning of agriculture.
- What is subsistence farming?
- What is the most common farming system in the Ethiopian context?

Remember to grade and rate the students' activities, levels of participation and results of quizzes/exercises.

1.2. The origin of domesticated crops

Period allotted: 1 period.

Learning Competencies

At the end of this lesson, the students will be able to:

- describe the origin of domesticated crops

Contents

- Origin of domesticated crops

Overview

In this unit, the students will learn how hunter-gatherers selected their food sources and how this led to the domestication of certain crop plants in agriculture. The hunter-gatherers used their own criteria to select what to gather as food sources. The criteria were critical in determining the types of crops domesticated in agriculture.

Teaching-Learning Process

Suggested instructional materials

- Pictures of hunter-gatherers, preferably of gatherers
- Pictures of domesticated crops

Suggested Teaching Methods

- Questions and answers
- Explanation

Presentation of the Lesson

a) Introduction to the lesson

You may begin the lesson by introducing the objectives of the lesson. Ask students questions on the previous lesson in the form of revision:

- How do you think hunter-gatherers decide what to gather for food?

- What type of domesticated crops do you know in your surroundings?

b) Body of the lesson

- Start by explaining to students some of the characteristics of plants that hunter-gatherers used to collect for their food
- Talk in short about the major criteria early man used in the decision of what to gather for food (Mention ease of harvest, availability, ease of transport, flavor, climate tolerance and predictability of availability as some major criteria)
- These characteristics influenced the domestication of wild plants

c) Stabilization

Give a summary of the following points.

- Explain the major criteria hunter-gatherers used to decide what to gather for food and how this influenced crop domestication

Assessment

At the end of the lesson, make sure that your students have understood the essential concepts of the lesson. Ask them questions and give them tasks like the following as class work and mark (grade) their written answers.

- What is domestication?
- What could have influenced the nature of crops that were first domesticated?
- How do you think is teff crop domesticated in Ethiopia?
- Provide your opinion about the characteristics of the teff crop that could have made it preferred for domestication?

Answers for activity 1.1 (suggested approach)

- The major criteria used by hunter-gatherers to select plants for food include:
  - ease of harvest

- seed size
- flavor
- climate tolerance
- ease of transport to residence
- wide availability and predictability of the availability across seasons

Teff is a relatively low risk crop with tolerance to climatic and other environmental stresses. It also possesses tolerance to insect pests and diseases. Moreover, it can mature and give harvest between 2 to 5 months after sowing. These qualities of the crop might have contributed in its domestication by Ethiopian farmers.

(1.3, 1.4) Status of crop production and classification of crop plants

Learning Competencies Periods allotted: 3 periods.

At the end of the lesson, the students will be able to:

- describe the status of crop production
- classify crop plants grown in Ethiopia

Contents

- Status of crop production
- Classification of crop plants

Overview

In this unit, the students will learn about Status of crop production globally and in the Ethiopian context. They will also learn the classification of crops into food crops, fiber crops, oil crops, and forage crops as well as into C3 and C4 crops.

Teaching-learning process

Suggested instructional materials

- samples of crop plants (grains or vegetative parts)

Pictures can also be used if samples are not available

Suggested teaching methods:

- Brainstorming and asking questions

Pre-lesson preparation

- Prepare real samples of crop plants, if available, or pictures of common crop plants

Presentation of the lesson

a) Introduction to the lesson

Ask students to discuss the following questions

- What do you think are the major activities in crop production? Discuss with your partner and then share your ideas with the class.
- List the major differences between the ancient and the modern crop productions in terms of yield.

b) Body of the lesson

- explain factors that determine the yield of crops
- explain the differences between geographic locations (altitude, temperature, rainfall, etc.) in agricultural productivity
- describe the status of crop production in Ethiopia. Mention also the major constraints to crop production in the country. (lesson 1)
- discuss classification of crops into different categories (food crops, oil crops, fiber crops and forage crops) (lesson 2)

Ask students to bring different seeds of crop plants to the class:

- Ask students to describe the seeds of the different crops in terms of seed size, color, their classification into either cereals, pulses, oil crops and so on.
- Students could also use wet tissue paper on Petri dish and spread the seeds and record the percentage of germinated seeds after 7 days to see if the seeds differ in their germination capacity

- explain about C3 and C4 plants (lesson 3)
- explain the differences between C3 and C4 crops in terms of their photosynthesis pathways. C4 plants naturally possess a mechanism to store CO_2 in the chloroplast and therefore can achieve high photosynthesis rates even at low CO_2 concentration. On the other hand, C3 plants lack the mechanism to store CO_2 and hence achieve high photosynthesis rate at higher CO_2 concentration. With climate change, the concentration of CO_2 in the atmosphere increases and this is going to affect C3 plants more than it affects C4 plants. The photosynthetic rates of C3 plants might increase with increase in CO_2 concentration but this is possible only if other growth factors like temperature and water are not limiting. However, with climate change, global temperatures increase and moisture availability in many areas would be expected to decrease and increased photosynthetic rates may not be achieved. Rather, photosynthetic rates would decrease and hence resulting in decreased yields, particularly in arid and semi-arid regions.
- ask students to work in pairs. One student should explain to their partner the characteristics of C3 plants and give examples. The other student should then explain C4 plants and give examples. Students should let their partner know of any mistakes or misconceptions and work together to ensure full understanding.

c) Stabilization➔Give a summary of the following points

- why agricultural productivity varies between regions?
- the status and the constraints of crop production in Ethiopia
- classification of crops into food, fiber, oil, and forage crops as well as C3 and C4 crops

Assessment and Follow up ➔ tasks, additional questions

To know whether the expected objectives/learning outcomes are achieved, ask the students questions about the topic. You can ask them questions like the following:

- What factors determine crop yields in Ethiopia?
- Give two examples for the following crop types:
  - Food crops
  - Oil crops
  - Fiber crops
  - Forage crops

Answers

Factors that determine yields in Ethiopia include:

- soil degradation
- recurrent droughts
- climate changes
- traditional farming systems with little technology use
- uncertain and variable rainfall
- very low level of irrigation and low use of inputs like improved seeds, fertilizers and pesticides

Students should be able to list at least two examples from each of the four types of crops.

Answers to Activities 1.2 and 1.3 (suggested approach)

For activity 1.2, encourage students to discuss their personal experiences of how any of the yield reducing factors have affected them, their families or communities. Let them share their findings with their classmates.

For activity 1.3, encourage students to visit a nearby market identify the different types of crops available in the market and classify them into the four major crop types they learned and into C3 and C4 crops.

Answer to bullet number 3

With climate change, the concentration of CO_2 in the atmosphere increases and this is going to affect C3 plants more than it affects C4 plants. The photosynthetic rates of C3 plants might increase with increase in CO_2 concentration but this is possible only if other growth factors like temperature and water are not limiting. However, with climate change,

global temperatures increase and moisture availability in many areas would be expected to decrease and increased photosynthetic rates may not be achieved. Rather, photosynthetic rates would decrease and hence resulting in decreased yields, particularly in arid and semi-arid regions.

1.5 Cropping systems

Periods allotted: 2 periods

Learning Competencies

At the end of the lesson, the students will be able to:

- explain cropping systems
- compare different cropping systems in terms of advantages and disadvantages

Contents

- Cropping systems

Overview

In this unit, the students will learn about mono-cropping, mixed cropping, relay cropping, and crop rotation.

Teaching-learning process

Suggested Instructional Materials

The Physical Map of Ethiopia to show the application/ use of different cropping systems

Suggested Teaching Methods:

- Questioning and gapped lecture

Presentation of the lesson

a. **Introduction to the lesson** – Revise the previous lesson, inform the students of the objectives of the lesson for the day. Introduce students to cropping systems by asking them about the crop types that are widely grown in their localities. Ask them also about the patterns of planting the crops.

b. Body of the lesson

- explain how cropping systems are classified into mono, mixed, relay cropping, and crop rotation
- explain that cropping systems refer to the types, number of crop species grown at a time, patterns, and timing of growing crops on a given farm
- explain the benefits of mixed cropping and crop rotation compared to mono cropping in terms of improved land use efficiency, reduction of risk of total crop harvest loss related to climate variability or crop pests and diseases, reduced crop diseases and pests and diversified harvests create opportunity for improved food and nutritional security (through mixing cereals and pulses) and improving soil fertility

c. Stabilization

Give a summary of the main points in the lesson:

- depending on the number of crops grown on a farm at a time, we have mono-cropping when only one species is grown at a time, if more, we have mixed cropping
- we sometimes change crop species we grow on a farm from year to year, the practice is called crop rotation. Crop rotation is important to reduce diseases and pests in crops and improve soil fertility compared to mono cropping.

Additional activity

- Encourage students debate mono-cropping vs mixed cropping
- One group should present an argument in favor of mono-cropping and the other oppose it.
- Give students time to prepare their speeches, which should cover the advantages of the system they are defending and the disadvantages

of the other system.

Assessment

You can use the following questions as class work to assess your students. Students should produce written answers and the answers have to be marked (evaluated).

- What is the benefit of crop rotation over mono cropping?
- What are the differences between intercropping, relay cropping, crop rotation and mono cropping?

1.6 Indigenous knowledge and crop production

Learning Competencies Period allotted: 1 period.

At the end of the lesson, the students will be able to:

- define indigenous knowledge and compare with modern knowledge
- explain the importance of indigenous knowledge in crop production
- state indigenous knowledge types in crop production and recognize their roles

Contents

- Indigenous knowledge and crop production

Overview

In this unit, the students will learn about indigenous practices used in crop production.

Teaching-learning Process

Suggested Teaching Methods:

- Brainstorming and interviews

Presentation of the Lesson

a. **Introduction to the lesson** – Review the past lesson, inform students about the objectives of the lesson. Ask them brainstorming questions

to find out about their background knowledge in relation to indigenous knowledge.

b. Body of the lesson ➔ Lesson Presentation

- explain farmers' use of indigenous practices in crop production- explain indigenous practices in crop production. Discuss indigenous land management practices seen among the Konso and Gumuz communities. They are good examples of improved soil management and controlled soil degradation. This reduces soil degradation and sustains crop yields
- discuss also indigenous practice of digging a trench around potato plant in the Bale area to protect the plant from crop pests which resulted in improved crop protection
- Encourage students to research an indigenous practice and then build a model to test how it works - for example students could make a small scale model of the Konso terracing using locally available materials, and pour water on to test how this prevents soil erosion.

c. Stabilization

Give a summary on:

- indigenous practices on crop pest management - farmers in Bale area raise trench around potato plants to protect them from pests
- mention indigenous soil and land management practices in Gondar, Konso, and Gumuz to reduce soil erosion and sustain crop yields
- explain the indigenous knowledge of crop rotation in the highlands of the country
- give student a home assignment to find out more indigenous agricultural practices (other than those covered in the lesson) used in the community and present to the class on what the practices are and how they are used in crop production.

Assessment

For assessment, you can give tasks like the following as classwork

- What is indigenous knowledge?
- How is indigenous knowledge used in crop production?
- What are the advantages of using indigenous knowledge in crop production?

Answers to Activity 1.4 (suggested approach)

Encourage the students to describe the indigenous practices they have identified and how these practices are used in crop production. Encourage the students to present their answers orally in the classroom

4. Answer Key to Review Exercise

Part I Multiple choice

1. D	3. B	5. D	7. C	9. B
2. B	4. D	6. B	8. B	10. A

Part II

1.

a. Agriculture: is the deliberate growing of crops and rearing of animals.

b. shifting cultivation: is a form of agriculture in which an area of ground is cleared of vegetation and cultivated for a few years and then abandoned for a new area

c. settled agriculture: the practice of using the same plot of land continuously over a long period to grow crops or rear livestock

d. subsistence farming: the practice of growing crops and raising livestock sufficient only for one's own use, without any surplus for trade.

2.

Farming type	Fertilizer and other input use	Technology use (mechanization)	Labor requirement	Output (yield)
Subsistence	Low	Low	high	low
Commercial	High	High	low	high

3. The yield of crops per unit area has remained the same for years or

declined. The cultivated area has increased at the expense of forests and grasslands. This has resulted in an increased volume of production.

4. Advantages and disadvantages of some common cropping systems

Cropping systems	Advantages	Disadvantages
Mono cropping	Single crop ➔ uniform management	Risk of crop failure in case of drought or diseases/pests
Intercropping	-Reduced risk of total yield loss -possibility to break the disease cycle -diverse products	-Higher labor requirement
Crop rotation	-Better disease and pest control	-

5. Indigenous practices of land and soil management reduce soil degradation and soil erosion. This sustains crop production

-Indigenous practices also help to better control crop pests and diseases and reduce yield losses due to crop diseases and pests

Check List

Check the student's performance against the learning outcomes.

Can you:

		Yes	Partly	No
1	define crop production-related terms/phrases?			
2	explain the origin of different domesticated crops? ---			
3	describe the status of crop production in your living area? ----------			
4	classify the major crop plants?----------			
5	discuss the different cropping systems and principles of crop production? ----------			
6	list importance of common indigenous practices used in crop production? ----------			

Unit Assessment

Students' performance has to be assessed continuously over the whole unit. You can determine whether the student has achieved the minimum required level of competence by comparing their performances against the specified level of competencies.

A student working at the minimum required level will be able to:

- define crop production-related terms/phrases,
- explain the origin of different domesticated crops,
- describe the status of crop production, classify the major crop plants,
- explain different cropping systems and principles of crop production, and
- explain importance of common indigenous practices used in crop production.

Students working above the minimum required level should be praised and their achievements recognized. They should be encouraged to continue working hard and not become self-satisfied.

Students working below the minimum required level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time during the breaks or at the end of the day.

Unit 2 Field Crops Production and Management

Periods allotted: 7 periods.

Unit Introduction

In this unit, the students will learn about field crops in general, and specifically about cereal and pulse crops produced in Ethiopia. They will also learn about the management requirements and the status of production of these crops.

Learning Outcomes

At the end of this unit, students will be able to:

- define field crops, cereal and pulse crops
- identify the major cereals and pulses produced in Ethiopia, elaborate their uses and management
- describe the status of cereal and pulse crops production
- explain the growth requirements of the major cereals and pulses produced in Ethiopia

2.1 Cereal crops production and management

Periods allotted: 4 periods.

Learning Competencies

At the end of this lesson, the students will be able to:

- discuss the importance, growth requirements and status of production of the major cereal crops in Ethiopia

Contents

- Importance, growth requirements and production status of the major cereal crops

Overview

Field crops are crops grown on a large scale for human consumption. These crops are annuals (finish life cycle in a single season) in their growth habits. The major field crops are classified in to two major groups called cereals and pulses (legumes).

Cereals: are crops with grass characteristics grown mainly for their edible seeds. Cereals can grow in a wide range of environmental conditions, from low lands to highlands and in different soil types and climates. Cereal crops are monocots, which means that the seed has a single cotyledon or embryonic leaf. As a result, during emergence they produce a single leaf. These crops are rich in:

- Carbohydrates
- Proteins
- Fats and
- Fibers

The five major cereal crops produced in Ethiopia are teff, maize, wheat, barley and sorghum in decreasing order of production area allocated to the crops. These cereals differ in their growth and management requirements as well as yield potentials and production constraints.

Teaching-learning Process

Suggested Teaching Methods

- Brainstorming, questions and answers, group and pair work

Presentation of the Lesson

a. Introduction to the lesson - Introduce students to field crops production by telling them the objectives/learning outcomes of the lesson and what field crops and cereal crops are and their specific growth requirements and management practices ask them also brainstorming questions. This will help you find out the students' background knowledge of the topic.

b. Body of the lesson

Presentation of the lesson

- explain what field crops in general and cereal crops in particular are in terms of their properties
- show students the various cereal crops (seeds or crops at different growth stages, if available) produced and used in the country so that they can see firsthand what the seeds or crops look like at different growth stages
- let the students discuss the major differences between the different cereal crops
- list the major benefits of cereals (nutritional and economic)
- describe the major cereal crops produced in the country in terms of benefits, growth and management requirements and production status

c. Stabilization

Give a summary on

- nutritional and economic roles of the major cereal crops
- each cereal crop is adapted to specific environments and has specific growth and management requirements and yield potential

Assessment

You can give students the following questions as home work.

- What are field crops?
- List the nutritional and economic benefits of the major cereal crops.
- What is your favorite food? Which crop is used to make your favorite food?
- Which cereal crop has the highest yield per unit area? Which has the lowest?

2.2 Pulse crops production and management

Periods allotted: 3 periods.

Learning Competencies

At the end of this lesson, the students will be able to:

- identify the major pulse crops produced in Ethiopia, understand their growth and management requirements, their uses and differences with cereals

Contents

- The production and management of major pulse crops in Ethiopia

Overview

In this section, students will learn about the major pulse crops, their production and management in Ethiopia. Faba bean, field peas and haricot beans are the major pulses produced in Ethiopia in terms of production volume. These crops possess the capacity to change atmospheric nitrogen into plant usable forms. The process is called biological nitrogen fixation. Integration of these crops as intercrops with cereals or in rotation improves nutrient availability for cereals and improves soil fertility. Pulses are rich in protein compared to cereals and hence important in improving nutritional security of farming families. Pulses like haricot bean are also cash crops that improve household income.

Teaching-learning Process

Suggested Teaching Methods:

- Brainstorming, questioning, small group discussion

Presentation of the Lesson

a. Introduction to the lesson - - Introduce students to pulse crops production by asking them brainstorming questions.

- What are pulse crops? Give three examples.
- How are pulse crops different from cereals?
- What pulse crops are produced in your localities?

b. Body of the lesson

Start the lesson by:

- revising the previous lesson (about cereal crop production) and telling the students the objectives of the lesson for the day
- listing the major pulse crops produced in the country and their differences with cereal crops
- explain the three major pulse crops, their characteristics, growth and management requirements, uses and yield potentials
- also explain about the nitrogen fixing ability of pulses and the advantages of including pulses as intercrops with cereals or in crop rotation

c. Stabilization

Give a summary of

- how pulses differ cereals and how the integration of the two crop groups benefits farming systems
- role of pulse crops in farming households and the national economy (haricot bean is an export crop)

Assessment

For assessment, you may give students the following questions as homework. Written answers should be marked (graded).

- List pulse crops produced in your surroundings and describe the production processes starting from planting to harvest by asking farmers/experts.
- Is their management different with that of cereal crops or the same? Why?

Answer to activity 2.1 (suggested approach)

- Help students by organizing a trip to a nearby farm so that they can make observations, ask farmers, experts about major crops produced, management practices and other information requested in the activity. Encourage students to share their findings with their classmates. If farmers are not available nearby, encourage students to search for information on major cereal crops management from literature (library, internet, etc.)

Answers to activity 2.2 (suggested approach)

Students should discuss in pairs the differences and similarities between cereals and legumes. One student could explain the characteristics of cereals and the other student about legumes and then they can discuss the differences and similarities.

Answer Keys to Review Exercise

Part I. Multiple choice questions

1. D	3. C	5. C	7. D
2. C	4. D	6. D	8. D

Part II.

1. Cereals include crops like teff and maize while legumes include crops like faba bean and haricot bean. Cereals are monocots while pulses are dicots. Pulses are capable of fixing atmospheric nitrogen and hence do not require nitrogen fertilizer application in most cases. Cereals require nitrogen fertilizer as they do not possess the capacity to fix gaseous nitrogen.

2. Teff, does not possess gluten and therefore is suitable for people who are allergic to gluten. Nutritionally, teff is rich in minerals like iron. The crop also is relatively disease resistant, and drought tolerant. Due to these qualities, it is sometimes called super food.
3. Soil cultivation can kill insect pests and burry weed seeds. Manual weeding, use of pesticides (chemical) and crop rotation are also used to control weeds, insect pest and crop diseases.
4. Below is a summary of answer for question 4.

	Broadcasting	Row planting
Advantages	▪ planting can be done faster	▪ suitable to carry out different management practices ▪ requires lower amount of seed
Disadvantages	▪ not suitable for management practices like weeding, fertilizer addition, harvest ▪ requires higher amount of seed	▪ Takes longer time at planting

5. Diverse yields (cereals and legumes which is good for nutritional security as the legumes are rich in protein), efficient use of the land resource by using it to produce more than one type of crop, control of some crop pests, diseases and weeds.

Check List

Check the student's performance against the learning outcomes.

Can you:

		Yes	Partly	No
1	define field crops …….....			
2	list the major cereal crops produced in Ethiopia, their importance, management and yield potentials and production constraints …			
3	list the major pulses produced in the country, explain their uses, growth and management requirements, yield potentials and production constraints …….....			
4	explain major differences between cereals and pulses and the benefit of their integration in farming systems .			

Unit Assessment

Students' performance has to be assessed continuously over the whole unit. You can determine whether the student has achieved the minimum required level of competence by comparing their performances against the specified level of competencies.

A student working at the minimum requirement level will be able to

- define field crops, cereal crops and pulse crops
- list the major cereals produced in the country and their growth requirements, yields and production constraints
- list the major pulse crops produced in the country and their growth requirements, yields and production constraints
- understand differences between pulses and cereals and the advantage of integrated production of these crops

Students working above the minimum requirement level should be praised and their achievement recognized. They should be encouraged to continue working hard and not become self-satisfied.

Students working below the minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time during the breaks or at the end of the day.

_____

_____

_____

Unit 3 Industrial Crops Production and Management

Periods allotted: 7 periods.

Unit Introduction

In this unit, students will learn about industrial crops belonging to oil crops, fiber crops and sugar crops produced in Ethiopia. They will also learn about the management requirements and status of production of these crops in the country and their economic contribution.

Learning Outcomes

At the end of this unit, students will be able to:

- define industrial crops, oil, fiber and sugar crops
- list the major industrial crops produced in Ethiopia
- identify the major uses and growth requirements of oil, fiber and sugar crops
- describe the status of industrial crops production and prospects in Ethiopia
- suggest ways of increasing the production and productivity of industrial crops, oil, fiber and sugar crops
- develop motivation for the production and management of industrial crops

3.1 Oil crops production and management

Periods allotted: 2 periods.

Learning Competencies

At the end of this lesson, the students will be able to:

- define industrial crops and oil crops
- identify the major oil crops, describe their uses, growth requirements and management

Contents

- Oil crops production and management

Overview

In this section, students will learn about the 2 major oil crops produced in Ethiopia. These crops are sesame and noug. Sesame is more adapted to low land agro ecologies whereas noug is more adapted to mid altitude areas of the country. Both crops are important raw materials for food oil production. Sesame is also an important export crop contributing to foreign currency earning.

Teaching-learning Process

Suggested Teaching Methods

- Question and answer

Presentation of the Lesson

a. Introduction to the lesson

- Introduce students to industrial crops production by asking what they understand by industrial crops

b. Body of the lesson

Present the lesson by:

- explaining what industrial crops are and the different groups of these crops (oil, fiber and sugar crops).
- explain what oil crops are, their uses, major oil crops, their growth and management requirements, yield levels and production constraints

c. Stabilization

Give a summary of the major oil crops, their uses

Assessment and Follow up

You can give the students the following questions as class work

- Which oil crops are produced in your surroundings?
- If present, describe the management practices used in the production by asking farmers or experts.
- What are these crops used for?

3.2 Fiber crops production and management

Periods allotted: 2 periods.

Learning Competencies

At the end of this lesson, the students will be able to:

- define fiber crops, list the major fiber crops, explain their growth requirements, management, uses and economic roles

Contents

- Fiber crops production and management

Overview

In this section, the students will learn about the two major fiber crops, cotton and sisal, their uses, production and management. They will learn about the economic contribution of these crops.

Teaching-learning Process

Suggested Teaching Methods

- Brainstorming, think-pair -share, interviewing family members, small group discussion

Presentation of the Lesson

a. Introduction to the lesson - Introduce students to fiber crops production by asking some brainstorming questions like

- What do you think are fiber crops?

- Can you give some examples?
- how many products can you name which you think come from fiber crops?
- What items in your house or school do you think are made from fiber crops?

b. Body of the lesson

Present the lesson by:

- explaining the major fiber crops and their uses and economic roles
- explaining cotton uses, growth and management requirements, production constraints and economic roles explaining sisal uses, production and management and its economic roles

c. Stabilization

Give a summary of

- the production and management, uses and economic roles of fiber crops production in Ethiopia

Assessment

For assessment, give the students questions below as homework:

- Which fiber crops are produced in your localities?
- How are fiber crops managed as compared to other crops?
- Describe the management practices used for these crops by asking farmers, experts or searching from literature

3.3 Sugar crops production and management

Periods allotted: 2 periods.

Learning Competencies

At the end of this lesson, the students will be able to:

- define sugar crops and
- explain the growth and management requirement of sugar cane, its production status and economic contribution

Contents

- Sugar crops production and management

Overview

In this section, the students will learn about what sugar crops are and mainly about sugar cane production and management, uses of cane processing products and economic contribution of the crop.

Teaching-learning Process

Suggested Teaching Methods:

- Question - answer, interviewing and reporting

Presentation of the Lesson

a. Introduction to the lesson - Introduce students to the production of sugar crops by asking them the types of sugar crops they know

b. Body of the lesson

Present the lesson by:

- explaining what sugar crops are
- tell them sugar cane is the major sugar crop produced and used for sugar production in Ethiopia
- explain the production and management of sugar cane together with production constraints
- explain the status of sugar production in the country

c. Stabilization

Give them a summary on the following points.

- explain the status of sugar production in Ethiopia,
- multiple uses of product and by-products from sugar cane processing

Assessment

For assessment, you can give students the questions below as class work. Students should produce written answers and their answers should be marked (graded).

- comparing the demand and supply of sugar in Ethiopia, is the supply adequate? If not, why is the supply lower than the demand?
- What needs to be done to fulfill the market demand, if demand is higher than the supply?
- In what ways will increased sugar production benefit the national economy?

Answer to activity 3.1 (suggested approach)

Encourage students to gather information from experts, make observations and search literature including the internet (if available) and prepare a report, submit the report and share their findings with their classmates. The reports should be evaluated and feedback should be given.

Answer Key to Review Exercise

Part I. Multiple choice

1. D
2. B
3. C
4. B
5. B

Part II.

1.

	Cotton	**Sisal**
Uses	Fibers used for production of different clothes and fabrics, oil extracted from seeds	Fibers used for production of ropes, carpets and sacks, paper
Characteristics	Soft fibers, propagated by seeds	Hard fibers, propagated by cuttings (vegetative)

	Cotton	Sisal
Growth & Management	drought tolerant, matures in about 7 months, weed control is critical	drought resistant, requires up to 3 years to mature, not much weed problems

2. Sugar cane is propagated vegetative by cuttings. It is a row planted crop at a spacing of 1.6 m between rows. The crop is a heavy feeder requiring nitrogen fertilizer addition of up to 150 kg per hectare. Weeding, insect pests and disease management are critical for sugar cane yield. Control measures include pre planting cultivation, removal of diseased plants and use of resistant sugar cane varieties. Harvesting takes about 18 months from planting. Controlled fire is sometimes used to remove leaves before harvesting the stem. The sugar cane stem is then processed in sugar factories and sugar and other useful products like bagasse and molasses are produced.
3. Sisal is a crop produced for its hard fibers used to make ropes, carpets, sacks as well as papers. The stem of sisal is also used for making fences, as firewood as well as in house construction. The crop is drought resistant and can be grown in a wide range of environments. It is propagated vegetatively. It is first grown from bulbils in nursery and transplanted to main field at about 40 cm height. It is usually planted in rows. It takes 2-3 years before the leaves are harvested.

Check List

Check the student's performance against the learning outcomes.

Can you:

		Yes	Partly	No
1	define industrial crops?.....			
2	list the major oil crops, explain their uses and their production and management?			
3	define fiber crops, explain the major fiber crops, their uses, their production and management and production constraints.....			
4	describe sugar cane production and management, uses and economic contribution?			

Unit Assessment

Students' performance has to be assessed continuously over the whole unit. You can determine whether the student has achieved the minimum required level of competence by comparing their performances against the specified level of competencies.

A student working at the minimum requirement level will be able to:

- define industrial crops, oil, fiber and sugar crops
- list the major industrial crops produced in Ethiopia
- identify the major uses and growth requirements of oil, fiber and sugar crops
- describe the status of industrial crops production and prospects in Ethiopia
- develop motivation for the production and management of industrial crops

Students working above the minimum requirement level should be praised and their achievement recognized. They should be encouraged to continue working hard and not to become self-satisfied.

Students working below the minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time during the breaks or at the end of the day.

Unit 4 Introduction to Farm Animals

Period allotted: 5 periods.

Introduction to the Unit

In this unit, the students will learn about the origin and domestication of common farm animals. In addition, the unit will introduce the students to the importance of domesticated animals and some major factors that affect the productivity of farm animals in Ethiopia, along with their mitigation strategies. Different animal production systems in Ethiopia are also presented in the unit.

Learning Outcomes

At the end of this unit, students will be able to:

- describe common terms used in animal production
- explain the origin and domestication of farm animals
- compare the gastro intestinal tract of a ruminant and a monogastric animal
- internalize the importance and values of farm animal production
- describe the constraints in animal production and their mitigation strategies
- identify the features of the different animal production systems in Ethiopia

4.1. Farm Animal Species

Periods allotted: 2 periods.

Learning Competencies

At the end of this section, the students will be able to:

- explain common terms used in animal production
- describe the origin and domestication of farm animals
- compare the digestive system of ruminant and mono-gastric animals

Contents

- Farm animal species
- Farm animals in Ethiopia
- Ruminant and monogastric animals

Overview

In this section, the students will learn about the definition, origin and domestication of farm animal species. Farm animal species include cattle, sheep, goats, camels and chicken as well as fish and honey bees. The scientific, family and genus name, probable period of domestication, functions, stomach type, feeding habit and suitable feeds of farm animals will be covered in the unit.

The most recent estimated farm animal population in Ethiopia is presented in Table 4.1 of the student's textbook. The unit also

- contain key terminologies used for various age and sex groups of farm animals
- compares the digestive system of ruminant and mono-gastric animals

Teaching-Learning Process

Suggested Instructional Materials

- Illustrations of anatomy and physiology of animals (cattle, sheep, goat, chicken, etc.).

Suggested Teaching Methods

- Brainstorming, Questioning, Small group discussion, Student presentation

Pre-Lesson Preparation

Illustrations of anatomy and physiology of animals, if available in your school pedagogy center, will help you to show the alimentary canal of farm animals. Alternatively, you can download illustrations of animals from the Internet and ask some students who are good at drawing to help you enlarge the illustrations. Biology department in your school may also have some way to help.

Presentation of the Lesson

a) Introduction to the lesson

You are advised to begin the lesson by introducing the objective of the unit in general and lesson objectives in particular. Then after you can conduct a brainstorming session by asking some of the following questions to draw the students' prior knowledge to the lesson for the day.

- name some farm animals kept at their or their neighbor's home
- list down the purposes farm animals serve at household levels

Let some students read their answers aloud to the whole class. Then, encourage other students to compare their answers to the ones read aloud to them. Don't let this activity go on far too long, anyway. Write a few of the most popular or interesting ideas on the board. This could serve you as the basis on which you build your presentation of that lesson. Five minutes may be sufficient for this.

b) Body of the lesson

Remember that the brainstorming session has laid an important basis for what you can do next.

- Give students introductory information on the basics of farm animal species. Explain briefly farm animal species and why they are reared.
- Introduce the concept, purpose and the probable period of domestication of farm animals. Give them time to take down important points raised so far in the lesson.
- Tell students the differences between species and breed.
- Explain the common farm animals in Ethiopia. Refer them to Table 4.1 in their textbook for information on the estimated population of each species. Give them time to think about the country's potential against the benefits gained. Ask them if they find the situation surprising, encouraging or frustrating.
- Describe briefly the 7 species of animals. Be consistent in your description of the species of animals. Consider aspects such as:
  - scientific name of the species
  - family and genus name
  - functions (why they are reared)
  - type of stomach (ruminant or monogastric)
  - feeding habit (herbivore or omnivore)
  - suitable feeds for each species.

Each species is supported with figures in a more visual format. Students are highly recommended to study the figures presented in their textbook. This is especially important in the cases of species that have different groups at species level. For example, see Fig. 4.1 for cattle, Fig. 4.4 for camel and Fig. 4.6 for different categories/roles in hierarchy of honey bees.

Note: The visual presentations are very crucial to assist students who have some hearing or listening impairments.

- Explain to students the digestive system of ruminant and monogastric animals. Give them examples of animals from each category. Tell students the main differences between the two classes in terms of:
- Digestive organs from mouth to anus
- stomach makeup
- feed preference
- digestion and absorption efficiency

- presence or absence of rumination and
- food habit

Encourage the students to compare the digestive system shown in their textbook (Fig 4.8 and Fig 4.9). This is quite important to reinforce learning. If possible, use a ready-made model illustrations that show the digestive tract of representative animals from each category.

- As an introductory unit to animal production, it is important that students know the proper terms used to refer to farm animals of different ages. Different terms are also used to refer to male and female farm animals of different ages. Table 4.1 below demonstrates this. Encourage students to study the information in the table.

Table 4.1. Key terminologies for the various age and sex groups of common farm animals

Species	Common name for new born of either sex	Young female	Young male	Mature female	Mature male	Castrated male
Cattle	Calf	Heifer	Bull	Cow	Bull	Steer
Sheep	Lamb	Ewe	Ram	Ewe	Ram	Wither
Goat	Kid	Doe	Buck	Doe	Buck	Wither
Camel	Calf	Heifer	Bull	Cow	Bull	Gelding
Chicken	Chick	Pullet	Cockerel	Hen	Cock	Capon

c) Stabilization

Give them summaries of the following points.

- Farm animal species
- Farm animals available in Ethiopia and their description
- Differences between ruminant and monogastric animals
- Terminologies used to refer to different age and sex groups of common farm animals

Assessment and Follow-Up

a) Assessment

AAt the end of the lesson, make sure that your students have understood the essential concepts of the lesson. Ask them questions and give them

tasks. The following may help as examples.

1. Name the two groups of cattle you learned in this lesson. What are their differences?
2. What is the difference between the Camelus dromedary and Camelus bactrianus?
3. What are the three types of bees in a honey bee hive?
4. Ask students to differentiate the digestive system of ruminant and monogastric animals.

b) Follow up

1. Summarise the description of different farm animal species you learned in this lesson.

c) Additional Questions

1. What is the difference between species and breed?

Answer for Activities and Additional Questions

Activity 4.1.

There are main differences between ruminant and monogastric animals.

No	Feature	Ruminant Animals	Monogastric Animals
1	Stomach makeup	Four compartments (rumen, reticulum, omasum and abomasum)	Single stomach
2	Feed preference	All types of feedstuffs	Easy to digest feedstuffs
3	Digestion and absorption efficiency	More efficient	Less efficient
4	Food habit	Herbivores	All types of food habit
5	Rumination	Yes	No
6	Representatives	Cattle, sheep and goat	Horse, chicken and pig

Answer key to additional question

1. A species is the largest group of animals that is capable of interbreeding and producing fertile offspring. A breed is, however, a specific group of domestic animals that has a homogeneous appearance, behavior, and other characteristics that distinguish it from other organisms of the same species.

4.2. Importance of Animal production

Period allotted: 1 period

Learning Competencies

At the end of this lesson, the students will be able to:

- explain the importance of domesticated animals
- list some examples of foods derived from farm animals
- identify some examples of socio-economic roles of farm animals

Contents

- Importance of Animal production

Overview

In this section, the students will learn about animal production and its importance. Milk, meat, egg, fish, honey, hides, skins, etc. examples of farm animal products. These products help the farm community in various ways.

Teaching-Learning Process

Suggested Instructional Materials

- Food and non-food products derived from farm animals: Milk, meat, egg, fish, honey, hides and skins, etc.
- Visiting milk, meat, leather factories, and poultry farms or if these are not available using You-tube videos makes more attractive to students.

Suggested Teaching Methods

Brainstorming - Question and answer – Lecture - Group/pair discussion - Individual work and teacher-led whole class discussions - student presentation

Pre-Lesson Preparation

Get the suggested instructional materials and teaching materials ready before the lesson. Try to identify and arrange a program to visit a food processing plant or other factories.

Presentation of the Lesson

a) Introduction to the lesson

Begin the introduction with brainstorming questions such as the following ones.

- What products of farm animals do you know in your area?
- What farm animal products do your community members use on a regular basis?
- What farm animal products are occasionally used in your home?

Ask students if they had any experience of observing or involving themselves in animal production. Elicit from those who had related experience information about the type of animal production area (e.g., poultry, dairy and fattening) they observed or were involved in; why they choose that type of animal production and what benefits they gained. In this way, you can understand their background knowledge and/or experience of animal production. You can also instill the love of farm animals in the students.

b) Body of the lesson

Build the body of the lesson in the foundation already created in the Introduction session.

You can do this by mentioning that

- millions of people depend on livestock for their livelihood worldwide
- the animal sector contributes immensely to the total agricultural gross domestic product (GDP), and to the total export earnings in Ethiopia
- animals are useful for work, clothing, feed, fertilizer or medicine, etc
- farm animals play key roles in the society's economic, cultural and social lives

c) Stabilization

Give a summary of the following points.

- Importance of domestic animals

Assessment and Follow-Up

a) Assessment

Check the students' comprehension of the lesson at the end of the lesson. Ask them these questions. Their answers will tell you the extent of their learning.

1. What roles do domestic animals play in the lifestyle of their owners?
2. List some examples of foods derived from farm animals.
3. List some examples of socio-economic roles of farm animals.

b) Follow up

Check the students' understanding of the lesson by giving them some exercise to do independently.

1. Write the roles of domestic animals you know in your locality. Remember to keep an accurate record of your student's performances.

c). Additional questions

1. In 2018, what was the contribution of livestock sector in Ethiopia to:
   a) Agricultural Gross Domestic Product
   b) Export earnings

Answer for Activities and Additional Questions

Activity 4.2.

Farm animals are primarily reared for food production, non-food products and work service. Their various byproducts are also utilized for clothing, fertilizer, medicine, livestock feed, etc. Farm animals also have economic and socio-cultural functions.

Answer key to additional question

1. The contribution of livestock sector in Ethiopia as of 2018
   a) 45-48%
   b) 16–19%

4.3. Constraints in Animal Production and Their Mitigation Strategies

Period allotted: 1 period

Learning Competencies

At the end of this section, students will be able to:

- explain the main constraints in animal production in Ethiopia
- suggest the possible mitigation strategies for each constraint

Contents

- Constraints in animal production and their mitigation strategies

Overview

Ethiopia is endowed with huge livestock resources that have diversified species and breeds of animals. However, the current production and productivity is by far lower than expected. In this lesson, students will learn about the factors that constrain animal production in the country. The section places special emphasis on the following major constraints: Feed shortage, genetic factors, animal diseases and parasites, traditional production system and socio-economic constraints.

Teaching-Learning Process

Suggested Instructional Materials

Flip chart, parker, etc.

Suggested Teaching Methods

Questioning, Explanation, Group discussion, Student Presentation

Pre-Lesson Preparation

Read the relevant content of the student's textbook, literature in the school's library or read any other sources on the main factors that affect animal production. Prepare notes and activities.

Presentation of the Lesson

a) Introduction to the lesson

Ask students to brainstorm their ideas about why animal productivity in Ethiopia may be low. Post a flip chart in front of the class. Ask students to write one factor that they think affects animal production the most on the posted flip chart. They will review their answer when the session progressed.

b) Body of the lesson

- Explain how each of the factors contributes towards lowering the productivity and reproductive potential of farm animals.
- Organize students into groups to do Activity 4.3 in their textbook. Encourage them to discuss factors that affect animal production in their localities or in the country. Give them any help that you think they need or if they ask for some. Encourage each group to suggest solutions. At the end, let them present the outcomes of their discussions to the whole class through group leaders.

c) Stabilization

Summarize the major constraints that affect animal production in Ethiopia. Give a chance to students to reflect on what they have write on the flip chat at brainstorming session. Students could work in groups to rank the factors they identified into a list from most important to least important. Then compare work between groups.

Assessment and Follow-Up

a) Assessment

Before the end of the lesson, make sure your students have understood the essential concepts of the lesson.

1. Ask students to mention three factors that affect animal production in Ethiopia.
2. Ask them to list some examples of animal diseases that are prevalent in the country.
3. Ask them to list some examples of socio-economic constraints in animal production.

b) Follow up Activities

Check the students' understanding of the lesson by giving them tasks to do independently.

1. Write the major factors affecting animal production?
2. Explain the features, advantages and drawbacks of indigenous breeds.

c) Additional Questions

Experts in the field tend to agree that local or indigenous breeds are well adapted to the local situations (high temperature, poor quality feed, diseases and parasites, etc), on the one hand and they are considered to be poor in their level of production, on the other hand.

Questions are set from this paradox as follows:

1. What do we mean by local or indigenous breeds? List their general characteristics.
2. What do we mean by poor level of production? Explain briefly by giving examples.
3. How can we overcome this paradox - improve the genetic potential of local breeds?

Answer to Activity

Activity 4.3.

Let the students discuss in small groups the major factors that affect animal production in their communities, using materials presented in their textbooks. Encourage each group to suggest possible solutions to the problems they have mentioned. Let them summarize the results of their discussion in a table, such as shown below.

Factors	Possible options
Feed scarcity	Promoting forage development programs, feed conservation (hay, silage making), improving grazing managements (rotational, deferred, zero grazing, etc.), adopting feed improvement technologies (chopping, urea treatment, urea-molasses treatment, etc)
Genetic factor	Selection, cross breeding, and new breed introduction
Health problems	Improving the existing animal health extension services
Traditional farming	Raising farmers' entrepreneurial awareness, recurrent capacity building, demonstrating the modern way of farming, availing credit facility and strong extension system
Other factors	Improving the existing management and socio-economic conditions.

Answer key to the additional questions

1. The local/indigenous breeds are animals which are originally present in the home country. They are native animals. Generally, they are characterized by their small size. They mature slowly and are poor producers. They are, however, adapted to local environment and are resistant to diseases. They also produce quality products such as milk, meat or eggs.

2. Poor level of production reflects the belief that indigenous breeds perform lower in terms of productivity per animal (e.g., growth rate,

milk yield, egg number, etc.). For example, indigenous cows' milk production ranges from 200 – 250 kg in a lactation period of 150 – 200 days. Local chickens start laying eggs at 8 months of age and lay 40-60 eggs annually. Also, the eggs are usually small in size (35-45gm). The same is true for other species.

3. Along with improving the feeding condition, disease prevention and control measures, improving the genetic potential of local breeds could be important to overcome the paradox. The local breeds have advantages of adaptation to the existing environmental conditions; however, they are blamed to be poor in their genetic potential. This is a paradox. To obtain a balance, there are three possible/alternative genetic improvement options (selection, cross breeding, and new breed introduction). These genetic options that focus on improvement of inherent genetic make-up of the local animals. Selection is a practice where best animals are mated to enhance productivity. In cross breeding, the exotic breeds are used to mate the local breeds to obtain cross breeds which possess the most desirable qualities of exotic and local breeds. The third genetic option is breed introduction. This is the process of replacing the existing local animal breeds by other new breeds.

4.4. Animal production systems

Period allotted: 1 period

Learning Competencies

- At the end of this section, the students will be able to analyze the features of the different animal production systems.

Contents

- Animal production systems

Overview

In this section, students will learn about the different systems of animal production in Ethiopia. The livestock production systems of Ethiopia are classified as:

- Extensive livestock production system
- Semi-intensive livestock production system
- Intensive livestock production system

Teaching-Learning Process

Suggested Instructional Materials

Flip chart, marker pen, etc. It is better to support teaching learning process through relevant YouTube Video session to animal production in Ethiopia.

Suggested Teaching Methods

Brainstorming – Questioning - Informal lecture - Teacher-led whole class discussion

Pre-Lesson Preparation

Look for YouTube videos on animal production systems in Ethiopia.

Presentation of the Lesson

a) Introduction to the lesson

Introduce the topic briefly using brainstorming questions. For example, you can ask them to write the characteristics of animal production system/s practiced in their community. Let the students complete the brainstorming session in pairs and discuss their answers.

- What did they conclude?
- Is the system traditional or modern or a combination of both?
- Ask two or three of the pairs to explain their reasons to the class.

b) Body of the lesson

Following the brainstorming session, introduce the body of the lesson subtly by explaining the different systems of livestock production in Ethiopia. These are extensive, semi-intensive and intensive systems. Students may find it useful to have the classification in a more visual format. One possible way of presentation is shown in Figure 4.12 of the students textbook.

Good to give them a detailed, but a clear description of each livestock production system. Use these parameters in your explanation of each system:

- the type of feed provided
- breeds kept
- housing system
- number of animals per farmer
- land size, production level, distance from town, etc.

Explain how each system is different from the others. This is useful to compare the intensive farming system against the extensive one (See Table 4.2 below).

c) Stabilization

Set students up for a debate - intensive v. extensive farming

Assessment and Follow-Up

a) Assessment

Close to the end of the lesson, check that the students have understood the essential concepts of the lesson. Ask them questions like the following ones:

1. Describe some features of extensive livestock production system.
2. List three examples of intensive livestock production system.

b) Follow up

Check the students' understanding of the lesson by giving them some activities to do independently.

1. Write the three systems of livestock production common in Ethiopia.
2. Explain the features, advantages and drawbacks of each production system.

Remember to assign values (e.g., marks) to the students' activities and participation levels.

c) Additional Questions

1. Write the main differences between intensive and extensive farming systems. Use a table to summarize the differences. The parameters to be used are: input level, animal density and type, output level and proximity to market.
2. What is the difference between market-oriented and subsistence-oriented farming systems?

Answer to Activities and Additional Questions

Answer key to the additional questions

1. Table 4.2. A comparison of Intensive and Extensive Farming Systems

Parameter	Intensive farming	Extensive farming
Input level	High labour and capital use	Low labor and capital input
Animal density	High animal population density compared to land size	Low animal population density to area/land available
Type of animals	Exotic or crossbred animals	Largely indigenous animals
Output level	Large output per land size	Small output per land size
Proximity to market	Generally closer to the market area	Largely distant from market area

2. A market-oriented farming system is the production of cash crops or animals and their products such as milk primarily for sale off the farm. Subsistence-oriented farming is the production of animals and crops by a farmer just to feed their family.

Answer Key to Review Exercise

Part I

1. D
2. A
3. B
4. C
5. C

Part II

1. Food and nutrition supply, livelihood, economy, work service, clothing, livestock feed, fertilizer, medicine, raw materials and socio-cultural roles.
2. Feed shortage, genetic factors, animal diseases and parasites, traditional production system and socio-economic constraints.
3. The difference among ruminant, pseudo-ruminant and monogastric animals is shown below.

   - **Ruminant animals** have stomach with four compartments. These are the rumen, reticulum, omasum and abomasum. They are more efficient in digestion and absorption of fibrous feeds. Examples are cattle, sheep and goats.
   - **Pseudo-ruminant animals** do not have a rumen, but they have an omasum, abomasum, and reticulum. Example is camel.
   - **Monogastric animals** contain single stomach. They are less efficient in digestion and absorption of feeds. Examples are chicken, pigs and horses.

Check List

Check the student's performance according to the given learning competencies, against the questions in the check list for the unit. Put a tick (√) mark against each task to show whether they are able to perform competencies of the unit. The students are expected to reply, saying 'Yes' or 'Partly' or 'No'. Or, you can make your own assessment to check whether or not the competencies are met.

Can you:

		Yes	Partly	No
1	explain common terms used in animal production?			
2	compare the digestive system of ruminant and monogastric animals?			
3	state the importance of domesticated animals? ….			
4	state the importance of domesticated animals? …			
5	describe the main constraints that affect animal production in Ethiopia? …….....			
6	identify the features of the different animal production systems?			

Unit Assessment

Students' performance has to be assessed continuously over the whole unit. You can determine whether the student has achieved the minimum required level of competence by comparing their performances against the specified level of competencies.

A student working at the minimum requirement level will be able to:

- define common terms used in farm animal production
- explain the origin and domestication of farm animals
- explain the importance and values of farm animal production
- describe the constraints in animal production and their mitigation strategies
- identify the features of different animal production systems

Students working above the minimum requirement level should be praised and their achievement recognized. They should be encouraged to continue working hard and not become self-satisfied.

Students working below the minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time during the breaks or at the end of the day.

Unit 5 Animal Feeds and Feeding Practices

Periods allotted: 6 periods

Unit Introduction

In this unit, the students will learn about animal feeds and principles of animal nutrition. Major contents of the units are feed resources, categories of feeds, the nutrient requirements and their sources, function, and how animals use the nutrients for healthy growth and productivity. Principles on formulation of a ration, proper conservation of feed and manufacturing compound feed are other areas covered in the unit.

Learning Outcomes

At the end of this unit, students will be able to:

- identify types of animal feeds and available resources in their localities
- categorize the different feed resources into roughages and concentrates
- describe the nutrient requirements of animals
- explain the functions and sources of the six basic nutrients
- analyze the factors to be considered in feed formulation
- formulate a ration using the Person's square method of ration formulation
- demonstrate feed conservation in terms of hay and silage
- state the main stages of compound feed manufacturing

5.1. Feed Resources in Ethiopia

Learning Competencies

Period allotted: 1 period

At the end of this section, students will be able to:

- explain concepts related to animal feeds and feeding practices
- identify types of animal feeds and available resources

Contents

- Introduction to animal feeds and feeding practices
- Feed resources in Ethiopia

Overview

This is an introductory section to animal feeds and feeding practices. The section focuses on the major feed resources available in Ethiopia. These are natural pastures, crop residues, improved forages and agro-industrial by-products.

Teaching-Learning Process

Suggested Instructional Materials

Some types of feed ingredients from each category (natural pastures, crop residues, improved forages and agro-industrial by-products) and YouTube video show.

Suggested Teaching Methods

Brainstorming – Questioning - Lecture – Pair-work – Students presentation

Pre-Lesson Preparation

Prepare your lessons in advance. Good to read related literature in addition to the textbook for the grade level to enrich your knowledge about animal feeds and nutrition. In reading literatures and taking notes from published and unpublished papers, you (the teacher) should acknowledge the author of the material. This might enlighten and discipline students the necessity of acknowledging and referencing authors and avoid plagiarism.

Presentation of the Lesson

a) Introduction to the lesson

Present introductory information on the feed resources and feeding practices including the contents and the corresponding specific objectives. Group the students in pairs to mention different feeds of farm animals that they already know. Encourage students to name as many feeds of farm animal as much as possible. From their list, students appreciate the various feed resources presented in their textbook. Give your students brainstorming tasks to help them recall their related prior knowledge. For example:

- Do farmers in your neighbor put their cattle to graze?
- What other feedstuff do farmers you know feed to their livestock?
- Where do they get the feedstuff they feed to their animals from?

b) Body of the lesson

Give them definitions of common terms used in animal feeding and nutrition. Feed, feedstuff, feeding, and animal nutrition .are some examples of common terms in the field.

Explain to students the importance of proper animal feeding and animal nutrition (The purpose of proper animal feeding and animal nutrition is to increase their profitability of livestock enterprise.)

Explain livestock feed resources available in Ethiopia. These are:

- natural pasture
- crop residues
- forage crops
- agro-industrial by-products

c) Stabilization

Give summaries of the following points.

- The importance of proper animal feeding
- The main feed resources in Ethiopia

Assessment and Follow-Up

a) Assessment

Check students' comprehension by asking questioning. Note that your questions reflect the stated lesson objectives.

1. What are the various types of crop residues?
2. List down the feed resources available in your area.

b) Follow up

To help your students learn better, you can get them to work on topics that are directly related to the lesson. For example, ask them to make notes in their books about the four main feed resources in Ethiopia.

Encourage the students to complete activity 5.1 in small groups. (Advise them to prepare lists of feed resources). Each group should present their work to the whole class.

c) Additional Questions

1. What are the major agro-industrial by-products commonly used as feed? Give examples of feeds from each industry.
2. List some factors that affect the nutritive value of natural pastures?

Answers to Activities

Activity 5.1.

1. The feed resources available may vary from location to location. Students may generally report natural pasture, maize, straw, wheat bran, wheat short, molasses, grass, etc.

2. The characteristics of grasses and legumes:

   - Legume plants have more leafiness with less structure. Thus, legumes tend to have less digestible fiber than grasses plants. Legumes, due to their abundant leaves, often have more protein, energy and micronutrients compared to grasses.

   - Grasses have narrow leaves with parallel veins and small, inconspicuous flowers. Stems are usually round and have visible

bulges or joints where the leaves attach (nodes). They are usually hollow except at the nodes. Grasses produce more biomass per unit area than legumes.

3. Students should find out more about the support available or groups that have built forage production venture in their vicinity. They have to assess producers' experience. This would help students to appreciate the attractiveness of forage production as a business in Ethiopia. At the end, you should summarize their finding.

Answer key to additional questions

1. There are four types of agro-industries which produce by-products of animal feed. These are flour milling industries, oil extracting plants, sugar factories and breweries.
   - Flour milling industries: e.g., wheat bran, wheat short, maize bran, wheat middling, rice bran and rice polish.
   - Edible oil extracting plants: e.g., soybean meal, noug seed cake, cottonseed cake, peanut cake, ground nut cake, etc.
   - Sugar factories: e.g., molasses, sugarcane tops, chaffs and beet pulp
   - Breweries by-products: e.g., spent brewery grain and spent brewery yeast
2. The nutritive value of natural pasture is most often affected by the altitudes, rainfall, soil type and cropping intensity. These factors also determine the availability of natural pasture.

5.2. Classification of Feed Resources

Period allotted: 1 period

Learning Competencies

At the end of this section, students will be able to:

- categorize feed resources into roughage and concentrate feeds
- identify roughage and concentrate feeds from each other

Contents

- Classification of feed resources

Overview

In the previous section, students were introduced to animal feed resources. This section focuses on the classification of the different feed resources. Feeds can be divided into two classes: roughage and concentrate feeds. In this section, you will study characteristics, subdivisions, importance and examples of roughage feeds and concentrates.

Teaching-Learning Process

Suggested Instructional Materials

Some forms of roughage feeds and concentrate feeds.

Suggested Teaching Methods

Brainstorming – Questioning – Gapped lecture – Think-Pair-Share

Pre-Lesson Preparation

Enrich textbook lesson through reading related materials.

Presentation of the Lesson

a) Introduction to the lesson

Begin gently by reminding students the different feed resources: natural pasture, crop residues, improved forages and agro-industrial by-products. Each group contains a wide range of feed items (i.e. ingredients).

Recap also what they have completed in activity 5.1. Refer them to their

earlier list of feeds common in their locality. Ask each group to make a table with two columns, one for roughage and the other for concentrate. Encourage each group to categorize the listed feeds into roughage and concentrate feeds.

b) Body of the lesson

Livestock feeds are divided into two classes: roughages and concentrates.

- Roughages are feeds high in fiber and low in total digestible nutrients. Examples are grass, hay, silage, straw, etc.
- Concentrates are feeds high in total digestible nutrients, and low in fiber. Examples are barley and other grains, cottonseed meal, soybean meal, wheat bran, molasses, etc.

Each feed classes are further divided into sub-categories. There is quite a lot for the students to understand in the classification of feeds and it needs to be explained sufficiently. Students sometimes find it useful to have such classifications in a more visual format. One possible way of presentation is shown in Figure 5.5 of the Students Textbook. From this starting point, a more detailed classification of each feed class can be built.

Explain to students the concept, characteristics, subdivision/classification, importance and examples of roughage feeds and concentrate feeds.

c) Stabilization

Give them a summary of:

- categories of feeds, descriptions of feed types in each category
- features of each feed type in the categories
- examples of each feed type

Assessment and Follow-Up

a) Assessment

Check students' comprehension by asking them questions. Note that your questions should be based on the stated specific objectives of the lesson.

1. What is the difference between roughage feeds and concentrate feeds?

2. Categorize the feed resources available in your area into roughage feeds and concentrate feeds.

b) Follow up

Make sure that the concept, characteristics, subdivision, importance and examples of roughage feeds and concentrate feeds are clear to your students. Students should complete activity 5.2 in small groups. In this activity, students will categorize the given feedstuffs as roughage and concentrate. Encourage each group to present their work to the whole class.

c) Additional Questions

1. Describe the importance of roughage feeds.
2. Describe the importance of concentrate feeds.

Answer to Activities and Additional Questions

Activity 5.2.

Roughage Feeds	Concentrate Feeds
Hairy coat haulm, hay, cassava, silage, natural pasture, soybean hulls, maize stover, teff straw	Maize, soybean meal, dried and wet distillers' grains, bakery meal, maize gluten feed, alfalfa, cottonseed meal, wheat middling, sorghum, alfalfa, soybean hulls, rice bran, oats, fish meal, edible insects, skim milk, wheat bran, molasses, mango kernel and maize bran

Answer key to additional questions

1. Functions of roughages

- Large farm animals are partly dependent on roughages in their ration.
- Roughages are the cheapest source of feed when they are of good quality.
- They provide bulk in the ration.
- Roughages stimulate rumen development in young ruminants.
- Dry roughages in the rumen prevent bloating in ruminants.

2. Functions (importance) of concentrates

- Concentrates are used to balance roughages by providing more protein and energy.
- Pigs and fowls are fed concentrates because they cannot digest roughages.
- Intensive meat and dairy production animals need to be supplemented by concentrates.
- Concentrates are used to fatten animals for slaughter.

5.3. Nutrient Requirements of Farm Animals

Period allotted: 1 period

Learning Competencies

At the end of this section, students will be able to:

- explain nutrient requirements of farm animals

Contents

- Nutrient requirements of farm animals

Overview

This section is about feed and nutrient requirements of farm animals. Common groups of animal nutrients are carbohydrates (or energy), proteins, fats, minerals, vitamins and water. Animals need minimum amounts of such nutrients to meet their real needs for maintenance, growth, reproduction, lactation, work and good health. This minimum amount of nutrients is called nutrient requirement. The functions and sources of each nutrient are discussed later in the section.

Teaching-Learning Process

Suggested instructional Materials

Real materials of different feeds or their pictures, charts of their list, etc.

Suggested Teaching Methods

Brainstorming – Questioning and answering – Pair-work activity –

Independent presentation

Pre-Lesson Preparation

Consult related references for further information on the topic.

1. https://livestock247.com/blog/2019/10/09/nutritional-requirement-of-livestock/
2. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=55168
3. https://www.nap.edu/collection/63/nutrient-requirements-of-animals

Presentation of the Lesson

a) Introduction to the lesson

Organize the students into pair and small groups. Ask them to identify feed and nutrient requirements of different species and category of animals.

b) Body of the lesson

Farm animals require six classes of nutrients: carbohydrates (or energy), proteins, fats, minerals, vitamins and water.

Provide students with sufficient explanation of the functions and the sources of each nutrient.

c) Stabilization

Give a summary of the following points.
Six classes of nutrients: (Briefly explain carbohydrates/or energy, proteins, fats, minerals, vitamins and water.)

- Explain the importance and the source of each nutrient.

Assessment and Follow-Up

a) Assessment

Check students' comprehension of the lesson near the end of the lesson. Ask basic questions and check the validity of their replies in light of the objectives of the section.

1. Ask students to list the six classes of nutrients required by farm animals.

2. Ask students to write the functions and the sources of each of the nutrients?

b) Follow up

Encourage students to complete activity 5.3 in pairs. Good to advise them to consult libraries, the Internet and other sources of information. Let them use tables to show functions of the six classes of nutrients and their sources. Allow them to present their work to the whole class if they wish and if there is enough time to do this.

c) Additional Question

Name the two groups of vitamins.

Answer for Activities

Activity 5.3

Nutrient	Function	Sources
Carbohydrates	Main source of energy for growth and activity	Cereal grains and their by-products, forages, crop residue, hay, silage, etc.
Fats	Source of energy for growth and activity	Oil seed cakes/meals
Protein	Essential for animals' healthy growth, maintenance and reproduction	Oil seed cakes/meals, pulse, legumes, fish meal, meat scraps, etc.
Minerals	Normal functions of the body, maintenance of good health, bones, teeth and tissues; regulate the body's chemical processes, etc.	Salt, limestone, green feeds, mineral preparations, etc.

Nutrient	Function	Sources
Vitamins	Required for metabolism, growth, reproduction, red blood cell maturation, digestion, bone and teeth formation	Green leafy feeds, vitamin premixes and other preparations, etc
Water	For digestion, blood circulation and waste elimination. It regulates body temperature.	Drinking water, water in feed and metabolic water

Answer to the additional question

Vitamins are grouped into two based on their solubility. These are the water-soluble and the fat-soluble. The water-soluble vitamins are B and C. Vitamin A, D, E and K are fat-soluble.

5.4. Feed Formulation Practices

Period allotted: 1 period

Learning Competencies

At the end of this section, students will be able to:

- describe the factors to be considered in feed formulation
- list the characteristics of a good ration
- exercise feed formulation through the Person's square method

Contents

- Feed formulation principles and practices
- Factors to be considered in feed formulation
- Types of ration
- Characteristics of a good ration
- Ration preparation methods

Overview

In this section the principles and practices of ration formulation are described. Also described in the section are types of ration, factors to be

considered in a ration formulation, the characteristics of a good ration, and the methods of ration formulation.

Teaching-Learning Process

Suggested Instructional Materials

Feed standards (tables) for different livestock species; small amounts of feed (maize, salt, soybean meal etc.) and scale.

Suggested Teaching Methods

Brainstorming – Questioning and answering - Lecture – Pair-work activity and presentation

Pre-Lesson Preparation

Remember to enrich the lesson in the textbook through supplementary reading on ration formulation. Some possible references are:

- Kellems O. Richards and Church C.D. 2003. Livestock feeds and feeding. Pearson education inc. USA
- Perry, T.W., A. E. Cullison and Lowrey, R.S. 2002. Feeds and feeding, 6th edition. 675pp
- Ranjan, S.K. 2001. Animal nutrition in the tropics and subtropics. Vikas publications.

Presentation of the Lesson

a) Introduction to the lesson

Recap the lesson in the previous section through asking about the six classes of nutrients required by farm animals. The nutrients are animals' real needs for maintenance, growth, reproduction, lactation, work and good health.

After telling the students about the objectives of the lesson, you can introduce the topic 'ration formulation' by posing questions like the following:

- What is a ration?
- Why is it necessary to provide animals with the right type of feed (i.e., a balanced ration)?

- How can we formulate balanced rations?

b) Body of the lesson

Begin your presentation by explaining the meaning of balanced ration and ration/feed formulation.

Tell them the two types of ration. These are the maintenance and the production ration. The first is required for survival or normal functioning of the animal body such as breathing, walking, digestion, etc. The animal neither gains nor loses weight. Ration is utilized by the animal body to produce valuable products such as milk, meat, egg, wool, growth, reproduce, etc.

Provide students with sufficient explanation of the information required in formulating a ration. Two types of information are required. See below.

a. Information on the feed ingredients - their feeding value, price, availability, physical form, restrictions levels, anti-nutritional factors, hazards, etc., and

b. Information on the nutrient requirement of the target aimal (DM, CP, ME, TDN, P, Ca, vitamins, etc.).

Describe to students the features of a good ration in terms of nutritional value, digestibility, palatability, bulkiness, etc.

Introduce to students the ways in which a ration can be formulated: the Trial and Error method, the Pearson Square method, substitution formulation and computer-assisted formulation. Give an emphasis to the Pearson square method. This is a well-known method of balancing animal diets. Show the students how the Pearson's square technique works. One example is presented in the student's textbook. This example gives you the opportunity to help the students understand the procedures of Person's method. Show them step-by-step how the method works. See the answer provided to Exercise 5.1 at the end of this section.

c) Stabilization

Ask students to formulate a ration containing maize and soybean at a ratio

of 800gm maize and 200gm soybean, as shown in the Student Textbook.

Assessment and Follow-Up

a) Assessment

Let students do exercise 5.1. This activity is designed to practice ration formulation, using two ingredients. Make sure that the students do the exercise individually. Help students refresh their understanding of how Person's square method can be used before letting them use the method. Give them time to complete the exercise properly.

Collect, read, mark and grade students' activities. Select the best ones and let the groups present them to the class. Others, (i.e., the less able groups) can take this as a model and do theirs again.

b) Follow up

Organize buzz-groups to discuss feed formulation for farm animals

c) Additional Questions

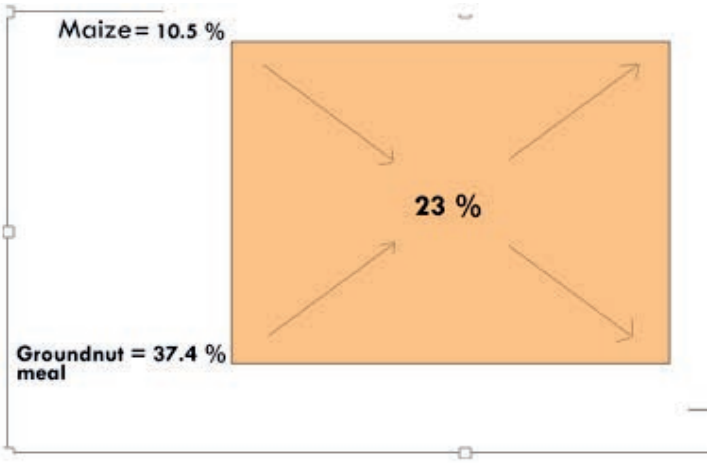
1. What are the two types of ration?
2. Write the characteristics of a good quality ration?

Answer for Activities and Additional Questions

Exercise 5.1.

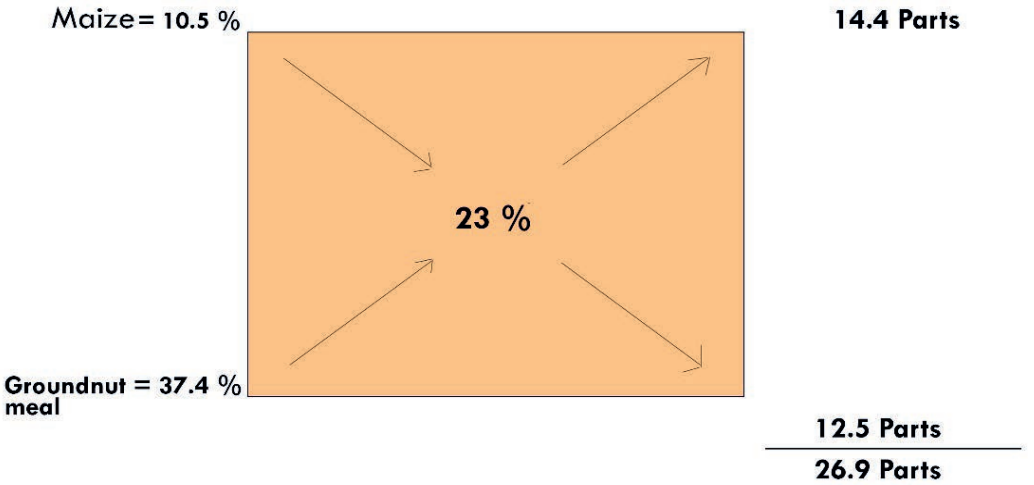
Follow the instructions below to find out the correct proportion of ingredients in the final ration.

1. Draw a square. Divide the square into four triangles by drawing a line from the top left-hand corner to the bottom right-hand corner, and from the top right-hand corner to the bottom left-hand corner.
2. In the centre, where the two lines cross, write down the amount of protein required. The amount in this case is 23%.
3. Write the protein content of maize grain and groundnut meal as illustrated below:



4. Subtract the percentage of protein content of the feeds from the required percentage of protein content. Write the answers in the opposite corners. The percentage of protein content in maize is 10.5, and 23 – 10.5 = 12.5. The percentage of protein in groundnut meal is 37.4, and 37.4 − 23 = 14.4 (Always subtract the smaller number from the larger one, as you cannot add negative amounts of protein to the feed). This means that 14.4 units of maize to 12.5 units of groundnut meal will ensure a 23% protein value.

Note: disregard the negative or positive value of the numbers.



5. Selam need to prepare 2000 kgs of this ration in the above proportion, the amount of maize and groundnut meal should be calculated as:
   - Maize: 14.4÷26.9 x 2000 = **1070.60 kg;**
   - Groundnut meal: 12.5÷26.9 x 2000 = **929.40 kg**

Therefore, Selam should make up the feed using 1070.60 kg maize and

929.40 kg groundnut meal to formulate 2000 kg of broiler feed with 23% CP.

Answer key to additional question

1. The two types of ration are the maintenance and the production ration.
2. The characteristics of a good ration

- Ration should satisfy the total dry matter requirement of an animal based on weight.
- It should provide highly digestible nutrients, enough minerals and vitamins.
- It must be palatable and it can be improved by addition of molasses or salt.
- It should be fairly bulky as it is required for satisfaction of hunger and expulsion of undigested material.
- It should be properly prepared to make it more digestible (e.g., grinding, crushing, etc).
- It should be fresh and free from undesirable weeds and dust.

5.5. Feed Conservation and Compound Feed Manufacturing

Periods allotted: 2 periods

Learning Competencies

At the end of this section, students will be able to:

- demonstrate feed conservation
- state the main stages of compound feed manufacturing

Contents

- Feed conservation (hay making and silage making)
- Compound feed manufacturing

Overview

This section presents forage conservation strategies, in particular hay and silage making. The production of compound feed, especially the main steps of manufacturing it is covered in the section.

Teaching-Learning Process

Suggested Instructional Materials

Fresh feed materials for silage and hay making, molasses, salt, scale, sickle, etc.

Suggested Teaching Methods

Brainstorming – Lecture– Field work/activity – Demonstration – Independent presentation

Pre-Lesson Preparation

Make the necessary preparation in advance of the lesson period. Read 'forage conservation strategies' in the students' textbook. Enrich your reading by reading supplementary materials.

Presentation of the Lesson

a) Introduction to the lesson

Brainstorm the class through asking forage conservation-related questions. Ask them what it is. Ask them also if people they know closely have

conserved forage, or if they have seen conserved forage themselves. Talking about the purpose of forage conservation will direct their attention to the problem of seasonal feed scarcity and its impact on farm animals' productivity.

b) Body of the lesson

Based on the descriptive and illustrative information given in the Students' Textbook:

- Explain to students the importance or the purpose of forage conservation
- Introduce them to the common methods of forage conservation
- Definitions of hay and silage, methods of making them, purposes the serve, their features, advantages, etc.
- Step-wise checklist for making and feeding a good quality silage (Table 5.2)
- Explain to students the procedure of silage making
- Provide students with sufficient explanation of compound feed manufacturing and the stages in manufacturing the feed.

c) Stabilization

Give summary of the following points.

- The concept of forage conservation
- Hay and silage making processes
- The main stages of compound feed manufacturing

Assessment and Follow-Up

a) Assessment

Create groups for field level feed conservation practice. Let them split themselves into groups and plan how to complete activity 5.4. Give them time to refresh their understanding of the steps of silage making before letting them conserve a typical feed.

The checklist in Table 5.2 of the Student Textbook contains activities at each step of silage making. Advise them to study the checklist before they begin planning. Once they have understood the steps, encourage them to

plan the activity. After planning, let them carefully implement the plan. Encourage them to write up the outcomes of their field activity. Advise them to present their work to the rest of the class. Check and grade students' activity.

b) Follow up

Ask the students to make notes in their notebooks on the common strategies of forage conservation (hay and silage making).

c) Additional Questions

1. What is the overall objective of forage conservation?
2. The two common strategies of forage conservation are hay and silage making. Despite their similarities, they have also differences. Summarize the main differences of hay and silage using the following parameters: moisture content, oxygen, storage methods, digestive capabilities, and preservation. You may use a table.

Answer for Activities

Activity 5.4.

This is a field activity on forage conservation. A detailed discussion has already been given in the student textbook, including a simple checklist and procedures for making a good quality silage. Therefore, you can assess the report and presentation of the students accordingly. Students should support their practical presentation with relevant photos which are captured during the practical session.

Answer key to additional questions

1. The primary goal of forage conservation is to make feed supply year round. This enable stability in animal productivity and profitability.
2. The summary of the main differences between hay and silage is presented below.

Table-5.2. Summary of the main differences between hay and silage

Parameter	Hay	Silage
Moisture content	12-15% (dried feed)	40-60% (wet feed)
Oxygen	Harvested and aerobically dried to be used as animal fodder	Anaerobically fermented and stored in a silo before used as feed
Storage methods	Mowed, dried and stored in bales	Compacted and stored in air-tight conditions without being dried
Digestive capabilities	Ruminant animals could completely digest with the help of rumen bacteria.	Silage is partially and easily digested, has more nutritious value
Preservation	Typically kept in a bale	Stored in a bale and covered with tight plastic wrap

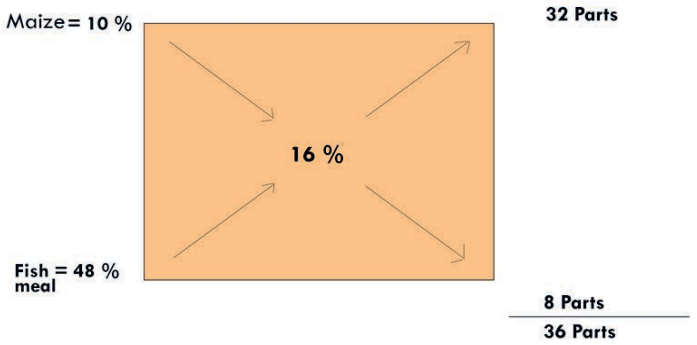
Answer Key to Review Exercise

Part I

1. B
2. C
3. B
4. A
5. C
6. C
7. D
8. A

Part II

1. Feeds are divided into two classes: roughages and concentrates.
   - Roughages are feeds which are high in fiber and low in total digestible nutrients. Examples are feeds as grass, hay, silage, straw, etc.
   - Concentrates are feeds which are high in total digestible nutrients, and low in fiber. Barley and the other grains, cottonseed meal, soybean meal, wheat bran, molasses, etc. are some of the examples.
2. Feed formulation



If the farmer aims at preparing 100 kg of the ration in the above proportion, how many kgs of maize and Fish meal should be mixed?

- Maize: (32 ÷36) x 100 = **88.90 kg**
- Fish meal: (8÷36) x 100 = **21.10 kg**

3. The main stages in the production of compound feed are:
    - Receiving and cleaning the raw materials (grains, brans, grass, fish meals, etc)
    - Selecting and storing raw material,
    - Weighing raw material
    - Grinding raw material
    - Creating a formula
    - Mixing dry ingredients and adding liquids
    - Pelleting mixed feed (optional)
    - Blending, labelling and storing feed package
    - Dispatching packaged feed

Check List

Check the student's performance according to the given competencies. Refer to the questions in the check list. Put a tick (√) mark against each task to indicate whether they are able to perform at the competencies required. The students are expected to reply saying 'Yes' or 'Partly' or 'No' to each item in the checklist. Make your own assessment on the basis of their replies to each item in the list – decide if the competencies are met.

Check the performance of students against the learning outcomes.

Can you:

		Yes	Partly	No
1	identify types of animal feeds and available resources?			
2	categorize the feed resources into roughages and concentrates?			
3	describe nutrient requirements of farm animals? ……			
4	explain functions and sources of basic nutrients?			
5	describe the factors to be considered in feed formulation? …..			
6	formulate a ration using the Pearson's square method? …….....			
7	demonstrate feed conservation in terms of hay and silage? ……			
8	state the main stages of compound feed manufacturing? ……			

Unit Assessment

Students' performance has to be assessed continuously over the whole unit. The assessment will be made by comparing students' performance with the specified level of competencies, to determine whether the student has achieved the minimum required level of competence

A student working at the minimum requirement level will be able to:

- identify types of animal feeds and available resources in their localities
- categorize the different feed resources into roughages and concentrates
- explain the nutrient requirements of farm animals
- describe functions and sources of basic nutrients
- analyze factors to be considered in feed formulation
- formulate a ration using the Pearson's square method of formulation
- demonstrate feed conservation in terms of hay and silage
- state the main stages of compound feed manufacturing

Students working above the minimum requirement level should be praised and their achievement recognized. They should be encouraged to continue working hard and not become self-satisfied.

Students working below the minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time during the breaks or at the end of the day.

Unit 6 Animal Genetics and Breeding Practices

Periods allotted: 5 periods

Unit Introduction

In this unit, the students will learn about the basic concepts of animal genetics and breeding, breed improvement methods, reproductive technologies used in farm animals and the importance of accurate identification and record keeping.

Learning Outcomes

At the end of this unit, students will be able to:

- define animal genetics and breeding practices
- explain breed improvement methods (breed introduction, selection and breeding)
- describe farm animal reproductive technologies (artificial insemination and embryo transfer)
- analyze the importance of animal identification and record keeping

(6.1, 6.2). Introduction to Animal Genetics and Breeding Practices, and Breed Improvement Methods

Periods allotted: 2 periods

Learning Competencies

At the end of this lesson, students will be able to:

- define animal genetic and breeding
- list the objectives of animal breeding
- explain breed improvement methods (breed introduction, selection and breeding)

Contents

- Concepts of animal genetics and breeding
- Objectives of animal breeding
- Breed improvement methods (breed introduction, selection and breeding)

Overview

In this section, students are going to learn about the concepts of animal genetics and breeding in farm animals. The objectives of animal breeding are also mentioned. The three methods of animal genetic improvement are discussed. These are breed introduction, selection and breeding.

Teaching-Learning Process

Suggested Instructional Materials

Pictures of farm animal breeds (local, exotic and cross breed), video show

Suggested Teaching Methods

- Brainstorming - Gapped lecture - Group discussion – Student group presentations

Pre-Lesson Preparation

Read the topic ahead of time.

Presentation of the Lesson

a) Introduction to the lesson

Introducing the students the objective of the daily lesson and letting students to discuss on the following points through brainstorming method so that the students relate the concepts to their biology classes.

- Animal genetics
- Animal breeding

b) Body of the lesson

- Provide introductory information on animal genetics and breeding. Explain to students the concepts of animal genetics and breeding
- Tell them the objectives of animal breeding
- Introduce to the students the topic of breed improvement methods. Emphasize on the three well known methods of breed improvement. These are introduction, selection and breeding. Let students to describe their definitions and analyze the advantages and drawbacks of each of the systems.

c) Stabilization

Give a short summary of the following points.

- objectives of animal breeding
- advantages and disadvantages of each of breed improvement methods

Assessment and Follow-Up

a) Assessment

At the end of the lesson, make sure that your students have understood the essential concepts of the lesson by asking them questions and giving them tasks like the following.

1. List the objectives of animal breeding.
2. Ask students to write the three methods of breed improvement.

b) Follow up

Students should complete activity 6.1. It is very important for you, the teacher, to monitor discussions and presentation and give feedback.

c) Additional Questions

1. Write the advantages and disadvantages of cross breeding?
2. Compare the characteristics, advantages and disadvantages of related and unrelated breeding systems? Provide examples of mating for each.

Answer for Activities

Activity 6.1.

Students in small groups, should investigate the animal breeding carried out in their own locality. They should research the success or difficulties that local farmers have encountered, and suggest ways that local farmers could improve their strategies in future.

Answer key for additional questions

1. Cross breeding one of the most rapid ways of making genetic change. Crossbred animals have a better standard production trait such as milk production, growth rate and production of overall animal performance than local animals. The disadvantages of cross breeding is sizing problems and associated delivery difficulties.

2. In related breeding system, animals with close blood tie are allowed to mate each other. This system enable the production of pure breeds or pure lines. However, it reduces vigor and performance what we call inbreeding depression. Examples of such breeding system are in-breeding and line breeding. Unrelated breeding system refers to matings between individuals from different populations, subspecies, or species or breeds. This results in an improvement in survival and reproduction (reproductive fitness). Examples of unrelated breeding system are out crossing, cross breeding and upgrading.

(6.3, 6.4). Animal Reproductive Technologies, and Animal Identification and Record Keeping

Periods allotted: 2 periods

Learning Competencies

At the end of this lesson, students will be able to:

- describe reproductive technologies (artificial insemination and embryo transfer)
- analyze the importance of identification and record keeping

Contents

- Reproductive technologies (artificial insemination and embryo transfer)
- Animal identification and record keeping

Overview

Reproductive techniques allow the dissemination of genes of interest and increase the reproductive capacities of animals. Over the years, various biotechnology methods are used in improving the breeding stock of animals. In this section, artificial insemination and embryo transfer are described briefly. In addition the importance of record keeping for successful breeding programs is presented at the end of the section.

Teaching-Learning Process

Suggested Instructional Materials

Diagrams or videos showing the process of artificial insemination and embryo transfer in farm animals Also, signs of heat in female animals.

Suggested Teaching Methods

- Gapped lecture - Think-Pair-Share – Digital learning (audio-video) –Field visit

Pre-Lesson Preparation

Read the topic ahead of time. Order students to read the topic on reproductive technology from their textbook or other relevant reference books. Prepare the suggested videos. Some useful links are:

- Artificial insemination in cattle: https://youtu.be/stvnGYcKz60?t=12
- Artificial insemination in cattle: https://youtu.be/vDIghmEiVW4?t=8
- Artificial insemination in sheep: https://youtu.be/Tmr40Irl54Q?t=90
- Artificial insemination in goat: https://youtu.be/98zSoVhBoJY?t=15
- Embryo transfer in cattle: https://youtu.be/YFMLxy4kjSQ?t=5
- Embryo transfer in cattle: https://youtu.be/KIv6OvMy4r0?t=10
- Signs of heat in cow: https://youtu.be/T1UHmFvJLvU?t=6
- How To Tell When Sheep Are Ready To Breed: https://youtu.be/2HlyapILlGU?t=48

Presentation of the Lesson

a) Introduction to the lesson

You can start this topic by organizing pair-group to discuss on reproductive technologies. Help students to stress on the definition, principle, advantages and drawbacks of artificial insemination (AI) and embryo transfer (ET).

b) Body of the lesson

Explain to students the topic of reproductive technology. Emphasize on the two well-known reproductive techniques. These are AI and ET. Describe their definition, principle, advantages and drawbacks of each of the systems.

Where possible, display the diagrams or videos prepared for this session. Display the video that presents artificial insemination and embryo transfer in some of the farm animals. Also, signs of heat in female animals. Help students to appreciate the displayed reproductive techniques.

Tell the importance of accurate record keeping for successful animal breeding programs; the two types of animal identification systems (temporary and permanent methods).

c) Stabilization

Summarize the following points:

- artificial insemination
- embryo transfer
- record keeping
- animal identification

Assessment and Follow-Up

a) Assessment (Self-assessment through checklist)

1. List the two reproductive techniques used in farm animals.
2. Write the signs of heat in female animals?
3. What is animal identification?

b) Follow up

Students should complete activity 6.2 and 6.3. It is very important for you, the teacher, to correct their presentation and provide timely feedback.

c) Additional Questions

1. What are the two methods of farm animal identification? Provide example for each method.

Answer for Activities and Additional Question

Activity 6.2.

This activity should be performed at the end of the section. Students in groups should think about the two reproductive techniques (i.e., artificial insemination and embryo transfer) which are covered in this section. Take one reproductive technique each and prepare a talk on the advantages and disadvantages of the technique.

Activity 6.3.

Students are expected to visit nearby animal farm/s and work on animal identification and record keeping. Students should write a report and submit to you.

Answer key for additional questions

1. There are two basic types of identification. These are the temporary and permanent method. Tail marking with a pen and chalk, clipping their hair, or dying their fur are some of the temporary or simple techniques to identify animals. Permanent methods of identifications include branding, ear tags, tattooing, ear notches or microchips.

Answer Key for Review Exercise

Part I

1. D
2. B
3. A
4. D
5. C

Part II

1. Advantages and limitations of reproductive techniques

Technique	Advantages	Limitations
Artificial insemination (AI)	Wider variety of superior males used, increase number of females that can be bread to a superior male, reduces spread of diseases such as contagious abortion and vibriosis, don't have to keep a male animal on the farm, etc.	Requires skilled technicians, effective AI work needs accurate herd supervision and heat detection, requires modern facilities such as Liquid Nitrogen

Embryo transfer (ET)	Quickly multiply the number of offspring of the top females, easier and more rapid exchange of genetic material between countries, no transport of live animals, reduces risks of disease transmission, storage and expansion of rare genetic stock, etc.	High cost of the technique, requires skilled technicians

2. Importance of record keeping in livestock farms

- Promote a successful genetic improvement program
- Help producers identify areas of weakness
- Eases the selection of new breeding stock
- Helps in making culling decisions

3. Methods of breed improvement

Method	Advantages	Disadvantages
Introduction	Introduced new animals not originally present in the home country, greater productivity, perform better, etc	Introduce new diseases and pests, adaptation problem, may not perform maximally, etc

Method	Advantages	Disadvantages
Selection	It ensures that only the best naturally available animal is selected. Animals with desirable characteristics are selected. Animals from best breeds are bred for distribution. Animals with undesirable characteristics are detected and rejected. Selection reduces the spread of diseases. It also reduces the spread of parasites associated with breeding stocks.	Selection is tedious and time consuming. It is very costly in terms of time and money. It requires expertise which may not be readily available. It brings about elimination or exclusion of some desirable traits of some parent stock. No new desirable characteristics are introduced
Breeding	The crossing or mating of superior animals from two different breeds produces an offspring that is superior to the average of either parent. Offspring grows more rapidly and is more economical to rear. In-breeding helps to produce pure breeds or pure lines and to concentrate and preserve specific qualities in an animal. Off springs produced can withstand variations within the environment.	It may result in in-breeding depression, drop in the production, poor resistance to diseases, etc

Check List

Check the student's performance according to the given competencies referring the questions under the check list for every unit. Put a tick (√) mark against each task weather they are able to perform in the competencies of each unit. The students are expected to respond saying 'Yes' or 'Partly' or 'No'. Then, you can make your own assessment whether the competencies are met or not.

Check the performance of students against the learning outcomes.

Can you:

		Yes	Partly	No
1	define animal genetics and breeding practices?			
2	explain breed improvement methods (breed introduction, selection and breeding)? ……			
3	describe animal reproductive technologies (artificial insemination and embryo transfer)?			
4	analyze the importance of identification and record keeping?			

Unit Assessment

Students' performance has to be assessed continuously over the whole unit. The assessment will be made by comparing students' performance with the specified level of competencies, to determine whether the student has achieved the minimum required level.

A student working at the minimum requirement level will be able to:

- define animal genetics and breeding practices
- explain breed improvement methods (breed introduction, selection and breeding)
- describe farm animal reproductive technologies (artificial insemination and embryo transfer)
- analyze the importance of animal identification and record keeping

Students working above the minimum requirement level should be praised and their achievement recognized. They should be encouraged to continue working hard and not become self-satisfied.

Students working below the minimum requirement level will require extra help if they are to catch up the rest of the class. They should be given extra attention in class and additional lesson time during the breaks or at the end of the day.

Unit 7 Farm Animals Housing

Periods allotted: 3 periods

Unit Introduction

In this unit, the students are going to learn about farm animals housing. The unit is intended to address the significance of farm animal house and the different types or systems of housing. In addition, student will gain insight on critical points that should be considered during site selection for animal house/shelter and construction details.

Learning Outcomes

At the end of this unit, students will be able to:

- explain the significance of farm animal house
- describe the different types of animal housing
- select sites for animal shelter and house construction
- construct model shelters and houses for animals

(7.1, 7.2). Significance of Farm Animal House, and Types of Farm Animal Housing

Periods allotted: 2 periods

Learning Competencies

At the end of this lesson, students will be able to:

- discuss the significance of farm animal house
- analyze the different types of animal housing

Contents

- Significance of farm animal house
- Types of farm animal housing

Overview

In this section, students are going to learn the main purposes and the types of farm animal housing. In this section, loose housing, conventional barns, free range system and modern farms are presented. The factors that should determine the choice of housing system are also indicated.

Teaching-Learning Process

Suggested Instructional Materials

Pictures or videos showing the different farm animal houses especially loose housing, conventional barns, free range system and modern farms.

Suggested Teaching Methods

Brainstorming – Questioning - gapped lecture - Group discussion and presentations - Demonstration - Audio-video method - field visit (observation)

Pre-Lesson Preparation

Refer materials that are relevant to the topic you are teaching. Read the topic ahead of time. Order students to read the topic on animal housing from their textbook or other relevant books.

Presentation of the Lesson

a) Introduction to the lesson

Before you start teaching the topic, supervise the extent to which your students are familiar with the topic. Inform the students about the objectives of the lesson and let students brainstorm on the purposes of animal housing by raising questions like:

- What do you think are the importance of animal house?
- How many types of housing do you know? What are they and how are they different?

b) Body of the lesson

Listen to your student's reflection carefully to the above question. This might help you identify how far your students have grasped the essence of the section topic. Then, make your presentation on the main purposes of farm animal house.

Explain to students the topic of types of housing. These are loose housing, conventional barns, free range system and modern farms. Describe their definition, features, advantages and drawbacks of each of the systems. Where possible, display the diagrams or videos prepared for this session. Help students to appreciate the displayed housing systems.

It is quite important to spend some time on the modern farm. This is because such farms produce the largest segment of foods of animal origin, especially in urban areas. They save space requirement. They are also the recent approaches. Animals are intensively managed and produce more. We have to stimulate our students towards modernization of livestock farming in order to meet the protein and micronutrient requirement of the rapidly increasing population.

c) Stabilization

Summarize the four types of housing (Conventional barns, loose housing, free range system and modern farms) as well as important factors in selection of housing type.

Assessment and Follow-Up

a) Assessment

1. Write the significance of animal housing.
2. As a homework/assignment tell the students to visit and carry out observation of different farm animal houses and prepare a report (in group or independently).
3. List the advantages of conventional housing system.
4. Write examples of modern farms.
5. Student' presentation of their field observation.

b). Follow up

Students should complete activity 7.1. It is very important for you, the teacher, to correct the practical report and provide timely feedback.

c) Additional Questions

1. Write the advantages and disadvantages of loose housing.
2. Write the factors that a farmers has to consider in choosing the type of housing system.

Answer for Activities and Additional Questions

Activity 7.1.

Students are expected to visit nearby animal farm/s and work on to describe the type animal housing. Students should write a report and submit to you.

Answer key for additional questions

1. **Advantages of loose housing**
   - The loose houses are cheaper to construct, easier to expand and flexible in utility.
   - Feeding and management of stock is easier because of common feeding and watering arrangement.
   - Animals are more comfortable as they move about freely.
   - At least 10 - 15 percent more stock than the standard can be accommodated for shorter periods without unduly affecting

their performance.

- Detection of heat in animals is easier.
- Animals also get sufficient exercise which is extremely important for better health production.

Disadvantages of loose housing

- More floor space is required when compared to conventional barn system
- Competition for feed and fodder among animals
- Individual animal attention is not possible
- Provision for a separate milking barn is needed
- Not suitable in heavy rainfall and temperate areas

2. Important considerations while selecting the type of housing system include the type of animal, kind of production system, climate condition, local tradition, availability of building materials and economics.

7.3. Guidelines for Site Selection and House Construction

Period allotted: 1 period

Learning Competencies

At the end of this lesson, students will be able to:

- select site for animal housing
- describe house construction details

Contents

- Guidelines for Site selection
- Guidelines for House construction

Overview

Once the types of housing systems is chosen for farm animals, the farmer will go for selection of good site. The next step is house construction. In this section, the general guidelines that should be considered during site selection and house construction are presented.

Teaching-Learning Process

Suggested Instructional Materials

Pictures or videos showing the different farm animal houses structures like floor, walls, roofs, orientation, ventilation systems, etc.

Suggested Teaching Methods

- Brainstorming – Gapped lecture – Digital learning - Field visit and reporting

Pre-Lesson Preparation

Arrange or organize the aforementioned suggested instructional materials. Plus, read the topic a head of time.

Presentation of the Lesson

a) Introduction to the lesson

Before you start teaching the topic inform the students on the objectives of the lesson and then, conduct a brainstorming session with the students asking questions like the following:

- What factors are considered while selecting a site for farm animal housing?
- What do you think might be important considerations in animal house construction?

b) Body of the lesson

Explain to students the various determinant factors that need to be considered as pre-requisite for establishing animal farms or houses. These include topography, drainage, accessibility (road, electricity, market outlet, etc.), distance from other farms/residences, availability of water, feed and veterinary services. Where possible, display the diagrams or videos prepared for this session. Help students to appreciate the displayed housing systems.

Describe the basic guidelines for construction of farm animal's house. These include orientation, floor, ventilation, roof, floor and walls. Stress

on the importance of ventilation, orientation, etc.

c) Stabilization

Summarize the following points.

- basic guidelines for site selection
- basic guidelines for house construction

Assessment and Follow-Up

a) Assessment (Self-assessment using the checklist developed)

1. Write the basic guidelines for house construction.
2. Write the basic guidelines site selection for animal housing.

b) Follow up

Students should carry out activity 7.2 and activity 7.3. Both activities are field day tasks that the student has to complete according to the specific instructions. They should prepare a summary report. It is very important for you, the teacher, to correct the practical report and provide timely feedback.

c) Additional Questions

1. What are the two types of orientations for animal houses? Compare them.

Answer for Activities and Additional Questions

Activity 7.2.

1. Students, in small groups, are expected and should exercise site selection for farm animals. This activity can be done within the school backyard. Students should present the outcomes of their discussions and submit report to you. You should correct their practical activities and provide feedback.

2. Students, in small groups, are expected and should visit a livestock farm in group that is found near their school or village. Students should write a summary report and submit within a week. You have to encourage them to share their observations to the whole class.

At the end, you should correct their practical activities and provide constructive feedback.

3. Students should construct a model house for animals and explain what animal is designed for and what features are present and why. Also explain what materials would be used and why.

*Students should write a project about site of housing, type of housing and house construction. Ask them also to present to the whole class.

Answer key for additional questions

1. There type of orientation is either East-West direction or North-South orientation.

The East-West direction,

- helps to avoid direct sunlight
- feed and water troughs could be placed under shade all times a day
- feed consumption will increase
- more manure will be dropped in the shade

In North-South orientation,

- sun will strike every part of floor area under and on either side of the roof
- keep dry floor area
- preferred to keep the area dry

Answer Key for Review Exercise

Part I

1. B
2. D
3. C
4. A
5. A

Part II

1. Topography, drainage, accessibility (road, electricity, market outlet, etc.), distance from other farms/residences, availability of water, feed and veterinary services

2. The four types of housing are loose housing, conventional barns, free range system and modern farms. The determinant factors of choice are the type of animal, kind of production system, climate condition, local tradition, availability of building materials and economics.
3. The basic guidelines for construction of farm animal's house include orientation, foundation, floor, ventilation, roof and walls.
4. The importance ventilation in animal houses to supply fresh air and to remove noxious and toxic gases such as CO2 and NH3. This gases are usually metabolic end products. Good ventilation system also helps to prevent dampness and thereby prevent the buildup of possible disease causing pathogens. Adequate air flow keeps the area comfortable and animals produce the maximum.

Check List

Check the student's performance according to the given competencies referring the questions under the check list for every unit. Put a tick (√) mark against each task weather they are able to perform in the competencies of each unit. The students are expected to respond saying 'Yes' or 'Partly' or 'No'. Then, you can make your own assessment whether the competencies are met or not.

Check the performance of students against the learning outcomes.

Can you:

		Yes	Partly	No
1	explain the significance of farm animal house? ……			
2	describe the different types of animal housing? ……..			
3	select a good site for animal shelter and house construction? …….....			
4	construct model shelters and houses for animals?			

Unit Assessment

Students' performance has to be assessed continuously over the whole unit. The assessment will be made by comparing students' performance with the specified level of competencies, to determine whether the student has achieved the minimum required level.

A student working at the minimum requirement level will be able to:

- explain the significance of farm animal house
- describe the different types of animal housing
- select sites for animal shelter and house construction
- construct model shelters and houses for animals

Students working above the minimum requirement level should be praised and their achievement recognized. They should be encouraged to continue working hard and not become self-satisfied.

Students working below the minimum requirement level will require extra help if they are to catch up the rest of the class. They should be given extra attention in class and additional lesson time during the breaks or at the end of the day.

Unit 8 Basic Animal Health and Disease Control

Periods allotted: 6 periods

Unit Introduction

In this unit, the students will learn fundamental concepts in farm animal health and disease control. The effects of diseases and parasites in animal production are explained in terms of production loss due to sickness, mortality (death), economic (financial loss) and zoonotic implications (human health risks). The unit consists of the major diseases of farm animals and their prevention and control methods. The importance of indigenous knowledge in livestock disease treatment is also addressed in the unit.

Learning Outcomes

At the end of this unit, students will be able to:

- explain the routes of transmission of pathogens
- list the common symptoms of sick animals
- recognize major diseases of farm animals (viral, bacterial, protozoan, and parasitic)
- describe the major groups of parasites in farm animals (internal and external)
- describe the effect of diseases and parasites in animal production
- explain the prevention and control of common farm animal diseases
- appreciate the role of indigenous knowledge in animal disease management

(8.1, 8.2, 8.3, 8.4). Introduction to Animal Health and Disease Control, Major Diseases of Farm Animals, Internal and External Parasites of Farm Animals, and Effects of Diseases and Parasites in Animal Production

Periods allotted: 3 periods

Learning Competencies

At the end of this section, students will be able to:

- explain routes of pathogens transmission
- identify the common symptoms of sick animals
- describe infectious and non-infectious animal diseases
- explain the major diseases of farm animals
- describe the main groups of animal parasites
- explain the effects of diseases and parasites in animal production

Contents

- Routes of transmission of pathogens
- Common symptoms of sick animals
- Major diseases of farm animals
- Internal and external parasites of farm animals
- Effects of diseases and parasites on animal production

Overview

Good and profitable animal production system refers to safe and high quality animal products. The best economic returns are realized when animals are kept in good health and disease problems are kept at a minimum. This section presents concepts of health and disease, routes of transmission, symptoms of sick animal, major diseases of farm animals, animal parasites, etc. Health is the state of wellbeing. A healthy animal performs to its full capacity. The farmers gain much from healthy animals. Farm animals are affected by several types of diseases and parasites. Most diseases are infectious while others are non-infectious. Infectious diseases are caused by pathogenic microorganisms. Non-infectious diseases arise from any sources other than pathogens.

Pathogenic micro-organisms are communicable from infected animal to healthy animals or humans. Their routes of transmission include

- direct contact - e.g., Newcastle disease
- ingestion - e.g., Anthrax
- inhalation - e.g., Tuberculosis
- urogenital during breeding/coitus - e.g., Trichomoniasis
- placental (between mother and offspring) - e.g., Brucellosis
- open wounds, or abraded skin - e.g., Foot rot
- mammary gland - e.g., Mastitis
- vector born - e.g., African Trypanosomiasis

Non-infectious diseases are caused by factors other than microorganisms. These may include injury, poisoning, chemical, toxins, malnutrition, mutation, etc. They are neither pathogenic nor communicable to animals or human.

There are also parasitic diseases. These are caused by internal and external parasites. Such types of diseases include the following, among others.

- African trypanosomiasis, also known as “sleeping sickness”, is caused by microscopic parasites of the species Trypanosoma brucei. It is transmitted by the tsetse fly (Glossina species), which is found only in sub-Saharan Africa.
- Babesiosis is s a disease caused by microscopic parasites that infect red blood cells.
- Leismaniasis is the phlebotomine sand flies borne disease caused by an intracellular protozoan parasite of the Leishmania donovani complex
- Toxoplasmosis is an infection with a parasite called Toxoplasma gondii. Animals often get the infection from contact with cat feces. The parasite can pass to a baby during pregnancy.

Internal parasites live inside the body of the animal - in one of the internal organs called predilection site. External parasites attack the external part of the animal. They affect the coat of the animal. This degrades the market value of skin, hide, mohair or wool.

Once infected, sick animals will show various symptoms. The symptoms are especially important in diagnosing the infected animal. Loss of appetite and weight, slow growth, reduction in production, reproduction loss and death of the animal are consequences of animal diseases.

Whatever their cause, diseases and parasites leads to morbidity (disease state), mortality (death), and economic loss to the farmer, the community as well as the country. Worse still, some animal diseases are communicable to human. Such types of disease that cause public health concern are called Zoonoses or zoonotic diseases.

Teaching-Learning Process

Suggested Instructional Materials

Pictures of healthy animals, sick animals, internal parasites, external parasites, etc.

Suggested Teaching Methods

- Brainstorming - Questioning – Gapped lecture - Think-Pair-Share

Pre-Lesson Preparation

Read relevant materials including the text book. Plan the lesson a head of time. Plan the number of activities to be done in the class by the students.

Presentation of the Lesson

a) Introduction to the lesson

- You can introduce the section with brainstorming questions. Use these questions to do this.
- Define the terms health and diseases.
- List some signs of sick animals you know.
- Mention some diseases that affect farm animals from your

experiences or local areas.

- Do you think humans and animals have common diseases?

b) Body of the lesson

- Introduce students to the importance of maintaining good health in animal production
- Tell students the consequences of disease
- Describe the various routes of transmission of pathogens (disease causing agents)
- List the general symptoms of sick animals
- Help students to distinguish the two categories of farm animal diseases (infectious and non-infectious). Mention their causes and the nature of their transmitability. Give them examples of diseases from both categories.
- Mention to the class the major diseases of farm animals in Ethiopia. You may describe some important diseases as presented in the students textbook. Don't forget to describe the diseases in terms of their cause, host, transmission, symptoms and preventative/control measures.
- Explain animal parasites - their definition, effect on animal performance, symptoms and classification
- Describe the internal parasites and give them some examples. Tell students how these parasites lead to loss of production and income.
- Do the same with the external parasites (Ectoparasites) - list some examples. Describe the parasites in terms of their site of attack, impacts on productivity and their role in disease transmission. Describe mange, scabies, red water and trypanomiasis.
- Finally, the effects of diseases and parasites in animal production. Their effect may be best explained in terms of mortality and death of animals as well as the economic loss and Zoonoses implications of the disease.

c) Stabilization

Give a summary of the following points.

- Definition of health disease, symptom, pathogen, parasite and Zoonoses
- Classification of disease and parasites
- Major diseases of farm animals
- Effects of diseases and parasites

Assessment and Follow-Up

a) Assessment

Ask the students the following questions as a class work.

1. List five routes of transmission of pathogens.
2. Write the effects of diseases and parasites on animal production.
3. Write the difference between internal and external parasites. Give examples for each category.

b) Follow up

Check that students have completed activity 8.1 and activity 8.2. In activity 8.1, a group of students should visit the nearby veterinary clinic. They should observe signs of healthy animals, symptoms of sick animals, health problems of farm animals in their locality and routes of transmission of pathogens. The activity 8.2 require students to fill the table with the list of appropriate diseases and/or parasites.

c) Additional Questions

1. Brucellosis affects the production of animals. This results in heavy economic loss to the farmer as well as the country.
   a) What is the other name of the disease?
   b) State the type of organism that causes Brucellosis.
   c) Explain how the disease transmits from one animal to the other.
   d) State the symptoms of the disease.
   e) Indicate how this disease is prevented and controlled.
   f) Is the disease communicable?

Answer for Activities and Additional Question

Activity 8.1.

Students, in small groups, are expected to visit the nearby veterinary clinic where they should observe signs of healthy animals, symptoms of sick animals, health problems of farm animals in their locality and routes of transmission of pathogens. Plus, they should ask the local vet about the most common diseases that occur in the local areas, and what treatments are offered. Students should present the outcomes of their field work and submit report to you. You should correct their field work activities and provide feedback.

Activity 8.2.

No	Infectious diseases	Non-infectious diseases	Parasitic diseases
1	Anthrax	Acidosis	African trypanosomiasis,
2	Foot and mouth disease	Ketosis	Babesiosis
3	Newcastle disease	Night blindness	Mange
No	**Zoonotic diseases**	**Internal parasites**	**External parasites**
1	Anthrax	Tape worm	Tick
2	Salmonellosis	Round worm	Lice
3	Taeniasis	Liver fluke	Fly

Answer key to additional questions

1. Brucellosis

a) Contagious abortion disease

b) Brucella abortus (bacteria)

c) Transmits through direct contact and ingestion of contaminated feed or soil

d) Male: enlarged testicles

Female: reduced milk flow; abortion and retained placenta

Male and female: intermittent fever; infertility and sterility

e) Good herd management and proper disposal of dead animals (burned or buried)

f) Yes, Brucellosis affects humans

8.5. Prevention and Control of Common Farm Animal Diseases

Periods allotted: 3 periods

Learning Competencies

At the end of this section, students will be able to:

- define the terms prevention and control
- describe the preventative and control measures of animal diseases and parasites
- appreciate the role of indigenous knowledge in animal disease management

Contents

- Preventative and control measures of animal diseases and parasites
- Indigenous knowledge in livestock disease treatment

Overview

IIn the previous section, we had looked at the concept of health and diseases, routes of transmission, symptoms of sick animal, major diseases of farm animals, animal parasites and the effects of animal diseases and parasites.

This section focuses on the prevention and control of common farm animal diseases. A doctor that takes care of animals is called veterinarian. The veterinarian must diagnose a disease on the basis of various examinations and tests. Some methods are physical and others are laboratory tests. Early diagnosis facilitates timely treatment. It can lower the veterinary cost.

Next, we will see the prevention and control methods of common farm animal diseases. Prevention is more effective and less costly than controlling diseases. The prevention and control of diseases and parasites involves a wide range of practices. Mention hygiene or sanitation, good

management, medication, quarantine, isolation, spraying or dipping, deworming, debeaking and biosecurity measures as examples.

The importance of indigenous knowledge in livestock disease treatment is also another focus of this section. The common diseases or parasitic symptoms that are treated by the traditional practitioners are explained.

Teaching-Learning Process

Suggested Instructional Materials

Knapsack sprayer, water, farm animals, etc., video show

Suggested Teaching Methods

Brainstorming – Gapped lecture - Field visit – Demonstration - Student presentation

Pre-Lesson Preparation

Plan your lesson before you get to class. Also, roughly investigate the application of indigenous knowledge in livestock disease treatment in your location. Read on the lesson's topics. Consult different reference books to supplement the ideas in the textbook.

Presentation of the Lesson

a) Introduction to the lesson

Introduce the section by asking students what they know about diagnosis, prevention and control of diseases. Encourage them to use lessons they can remember from their previous sections. Next, define the terms prevention and control. The terms will frequently be used in this section.

Also, introduce the class to the concept of indigenous knowledge in livestock disease treatment. Get them to appreciate the commitments the traditional practitioners or local farmers have to treat their sick animals.

b) Body of the lesson

Explain to the students the importance and methods of diagnosis of farm

animal diseases

Encourage the students to discuss the preventative and control measures of diseases and parasites in livestock farm.

- Students must be able to distinguish between the two related terms:
  - Prevention: measures applied before the occurrence of diseases. The goal is to prevent the occurrence of a disease.
  - Control: measures applied after the disease has occurred. The goal is to prevent further transmission from the infected to the healthy animals.
- Explain the disease and parasite prevention and control practices. Use the student's textbook as idea source. The following are some of the common diseases and parasite prevention and control strategies in livestock farm.
  - Hygiene or sanitation, good management (proper nutrition, housing, etc.), medication (vaccination, treatment with drugs, etc.), spraying or dipping, deworming, debeaking, biosecurity, etc.
- These methods are used to promote good animal health through controlling diseases and parasites in livestock farms. Point out to the students that most of the methods are applicable to all farm animals.
  - Demonstrate the knapsack spraying to control external parasites in large animals. Students could try using it (with water, not chemicals!). (https://www.youtube.com/watch?v=cWHpFdZ7hsI)

Discuss the role of indigenous knowledge in livestock disease treatment. Point out to the students that traditional medicines are cheaper than scientific drugs. Mention also that there are specific plant parts that are used for livestock health treatment. Their preparations and application methods are different from that of scientific drugs. Give them examples of diseases and parasite syndromes treated by traditional practitioners, etc. If traditional medicine people can be found in the school vicinity, try using them, either as idea source or a guest teacher.

c) Stabilization

Give a summary of the following points.

- Diseases and parasites preventative and control methods
- Ethno-veterinary medicines

Assessment and Follow-Up

a) Assessment

Check student's comprehension using questions like the following ones.

1. Ask students to list the methods of prevention and control of diseases and parasites in livestock farm.
2. What is the most common method of traditional drug application?

b) Follow up

Advise the students to make/take their own notes throughout the lesson periods. Encourage them to do activity 8.3 following the instructions in the Student Textbook. Remind them to write the outcome of their field visit. Allow them to share their findings with the whole class. Observe and grade the students' activities.

c) Additional Question

1. Write examples of traditional treatment of animal diseases (including indigenous plants etc).

Answer to Activities

Activity 8.3.

This activity is a field visit activity. Arrange for the students to observe the traditional way of animal health treatment in their locality. Talk to people in position in this regard. There are offices of traditional medicine practitioners (for both human and animal diseases) in big towns in the country. Consult them if they are available in your area. Encourage them to share their findings with the whole class. Different findings are expected to be reported to the whole class.

Answer to additional question

1. The table Common Botanical Products in Veterinary Medicine includes a diverse group of examples comprise a diverse group of phytotherapeutics commonly considered to treat pain and/or inflammation. Go through the link.

Answer Key to Review Exercise

Part I

1. C 2. B 3. D 4. B 5. D 6. C

Part II

1. **Health** is the state of being free from illness or disorder or injury. **Disease** is a particular abnormal condition that negatively affects the structure or function of all or part of an organism. **Symptom** is a sign or the indication of the existence of a disease or other disorder, especially experienced by sick animal. **Control** is a measures applied after the disease has occurred. The goal is to prevent further transmission from infected to healthy animals. **Prevention** is a measure applied before diseases occur. The goal is to prevent the occurrence of a disease.
2. Symptoms of sick animals may include loss of appetite, weight loss, coughing, unable to rise, slow movement, lameness, isolation from the herd or flock, stands with its head and neck down, or appears to have a tired or lazy look, watery, bad smelling or blood stained faeces and urine, occurrence of discharges from body openings, sunken eye, raised hair coat, rough skin, dry muzzle and swelling in joints. There may be variation in body temperature, pulse rate and respiration rate. Sickness may also lead to death
3. The effect of diseases and parasites on animal production include productivity reduction (morbidity), death (mortality), economic loss and public health concern (zoonoses).

4. The different principles of prevention and control of diseases and parasites in farm animals include hygiene or sanitation, good management, medication, quarantine, isolation, spraying or dipping, deworming, debeaking and biosecurity measures.

Check List

Check the student's performance according to the given competencies referring to the questions under the check list. Put a tick (√) mark against each task to see whether they are able to perform at the desired competencies. The students are expected to reply 'Yes' or 'Partly' or 'No'. Based on this, you can make your own assessment whether the competencies are met or not.

Check the performance of students against the learning outcomes.

Can you:

		Yes	Partly	No
1	explain the routes of transmission of pathogens? ……..……			
2	identify the general symptoms of sick animals? ……			
3	explain the major diseases of farm animals? ……			
4	describe the two groups of animal parasites?			
5	explain the effect of diseases and parasites on animal production? …….			
6	describe the preventative and control measures for animal diseases and parasites?			
7	explain the role of indigenous knowledge in animal disease management? …..…			

Unit Assessment

Students' performance has to be assessed continuously over the whole unit. The assessment will be made by comparing students' performance against the specified level of competencies. This will help determine whether the student has achieved the minimum required level.

A student working at the minimum requirement level will be able to:

- explain the routes of transmission of pathogens
- identify the common symptoms of sick animals
- recognize major diseases of farm animals (viral, bacterial, protozoan, and parasitic)
- describe the two groups of parasites (internal and external)
- describe the effect of diseases and parasites in animal production
- explain the prevention and control of common farm animal diseases
- appreciate the role of indigenous knowledge in animal disease management

Students working above the minimum requirement level should be praised and their achievement should be recognized. They should be encouraged to continue working hard and not become self-satisfied.

Students working below the minimum requirement level will require extra help if they are to catch up the rest of the class. They should be given extra attention in class and additional lesson time during the breaks or at the end of the day.

Unit 9 Dairy Cattle Production and Management

Periods allotted: 8 periods

Unit Introduction

In this unit, the fundamental practices of dairy cattle production and management are covered in terms of major breeds of dairy cattle, selection of breeds and individuals, feeding, housing and health care as well as milk production and processing.

Learning Outcomes

At the end of this unit, students will be able to:

- describe different dairy cattle breeds and their selection criteria
- describe dairy cattle feeding management
- explain milk production and processing
- internalize the concept of lactation cycle in dairy production
- realize dairy cattle housing, sanitation and manure management
- list major diseases of dairy cattle and control methods in their localities
- calculate profitability in dairy business

(9.1, 9.2). Introduction to Dairy Cattle Production and Management, and Dairy Cattle Breeds and Their Selection

Periods allotted: 2 periods

Learning Competencies

At the end of this lesson, students will be able to:

- describe overview on dairy cattle production and management practices
- identify different dairy cattle breeds and selection methods

Contents

- Introduction to dairy cattle production and management
- Dairy cattle breeds and selection

Overview

In this unit/section, students are going to learn about the dairy cattle breeds and how to choose the right type of breed and individual cattle.

Teaching-Learning Process

Suggested Instructional Materials

Pictures or videos showing the different dairy cattle breeds and their body parts

Suggested Teaching Methods

- Brainstorming – Think-pair-share - Gapped lecture - Questioning - Group discussion – Demonstration – Digital learnings

Pre-Lesson Preparation

You are advised to explain the objectives of the unit/lesson to the whole class. The teacher is expected to read on the topics of the lesson from different sources, and collect materials that can help him/her present as instructional materials to make the lesson clear and students attain the objectives of the lesson. Prepare relevant videos such as:

- Dairy cattle breeds: https://youtu.be/W4wleuetT5k?t=6
- Highest Milk Producing Cow Breeds: https://youtu.be/W4wleuetT5k?t=6

Presentation of the Lesson

a) Introduction to the lesson

You can start the unit by asking students in pairs what they already know about dairy cattle production or dairying. Then, provide introductory information on dairy cattle production and management.

b) Body of the lesson

Introduce students to concept of dairy cattle production and management. Tell them the production cycle how the calf or heifer reaches to produce milk.

Allow students to discuss in small groups to complete the respective brainstorming at sub-section level (9.1, 9.2 and 9.3). They should share their summary points to the whole class.

Help students to distinguish the characteristic of Bos indicus and Bos taurus cattle (Table 9.1.)

Explain sufficiently the major breeds of dairy cattle. These may include both the local cattle breeds and those exotic dairy cattle breeds that are common in our country. In particular, Holstein Friesian and Jersey. Tell students the features of each of the breeds. Display the pictures or videos you already arranged in advance to reinforce students learning. You should encourage students appreciate the features exhibited by each cattle breed.

Display the video deal about dairy cattle breeds, and summarize the main points later on.

Introduce the topic of dairy cattle selection methods. Apparently, a farmer should select appropriate animal from the available breeds as well as suggest a dairy character for a better milk production. There are essential points that should be considered in choosing both the ideal breed and the individual cattle. Explain those important considerations to choose breed and individual cows. If possible, display pictures or videos showing the physical characteristics of high yielding dairy cow like Figure 9.7. This

helps students to understand easily what the ideal cow should look like.

c) Stabilization

Give a short summary of the following points.

- Characteristics of Bos indicus and Bos taurus
- Major breeds of dairy cattle
- Choosing breed
- Choosing individual cattle

Assessment and Follow-Up

a) Assessment

At the end of the lesson, check knowledge of students by question and answer.

1. List the criteria used to select good dairy cattle breed.
2. Which exotic dairy cattle breeds are common in Ethiopia?
3. What are the features of local cattle breeds?
4. List the criteria used to choose high producing dairy cattle.

*In addition to asking the students to respond to the above questions orally or in a written form, you can assess students' learning through the group/ independent presentations.

b) Follow up

Students should successfully complete activity 9.1

c) Additional Questions

1. Write the indicators of good productive dairy cattle?
2. Write the names of the six major breeds of dairy cattle in the world?

Answer for Activities and Additional Questions

Activity 9.1.

The important considerations when selecting breed and individual animals for commercial dairying:

- The choice of breeds depends upon several factors. In selecting the ideal breed for a dairy herd, consider the prevailing climatic conditions, production objective (fresh milk or butter), feeding system, age of maturity, cost, etc.

- Give much consideration in choosing the animals-which are to form the foundation of a new dairy herd: Physical characteristics (general appearance, dairy character, body capacity and mammary system), performance records, free from diseases, etc.

Answer key for additional questions

1. General appearance, dairy character, body capacity and mammary system are the indicators of good productive dairy cattle.
2. Holstein-Friesian, Ayrshire, Brown Swiss, Guernsey and Jersey

9.3. Dairy Cattle Feeding Management

Periods allotted: 2 periods

Learning Competencies

At the end of this lesson, students will be able to:

- explain feeding management of dairy cattle

Contents

- Feeding management of dairy cattle

Overview

The ultimate objective of dairy cattle production is to harvest the maximum milk. This require feeding of cattle good quality and sufficient amount feed resources. Feed alone constitutes 60% of the production cost of milk. The focus of this section is feeding management of dairy cattle.

Teaching-Learning Process

Suggested Instructional Materials

Feed resources such as grasses, hay, grains, and also feeding/watering equipment at least in pictures

Suggested Teaching Methods

Brainstorming - Gapped lecture, questioning – Independent study - Group discussion

Pre-Lesson Preparation

Refer to materials that are relevant to the topic you are teaching. You can look at the links:

1. https://www.msdvetmanual.com/management-and-nutrition/nutrition-dairy-cattle/feeding-and-nutritional-management-of-dairy-cattle
2. https://snv.org/assets/explore/download/dairy_cattle_feeding_and_nutrition_management_training_manual_and_guideline_0.pdf
3. https://www.veeproholland.com/wp-content/uploads/2021/05/VeeproFeeding1Managementsmall.pdf

Presentation of the Lesson

a) Introduction to the lesson

Before presenting the lesson to the students, you should brainstorm the students so as to identify their areas of weaknesses and strengths and thereby plan your instruction. You can start your lesson by raising questions like the following.

- What cattle feed resources are available in your community?
- Why do dairy cattle fed on roughage feeds like crop residues and hay?
- Is there any feed supplement provided to dairy cow in your area?

b) Body of the lesson

Discuss the two classes of feed resources for dairy cattle. These are roughages and concentrates.

Describe the feeding management of dairy cattle

State the indicators of adequacy or inadequacy of daily dry matter intake of dairy cattle. This is presented in students textbook. Help students to understand Table 9.2.

c) Stabilization

Give a short summary of:

- Feeding management of dairy cattle

Assessment and Follow-Up

a) Assessment

At the end of the lesson, check knowledge of students by question and answer.

1. Can you list down some feeds of dairy cattle?
2. Can you write the importance of feeding roughages in comparison to concentrate feeds?

b) Follow up

Students must be in pair and should complete activity 9.2 (Think-Pair-Share).

c) Additional Questions

1. What would happen to the cow when the daily dry matter intake is below the required?
2. Write factors that affect the water requirement of lactating cow?

Answer for Activities and Additional Questions

Activity 9.2.

Students should answer this activity after reading the scenario presented. They should work in pair. Then they should share their answers with some students sitting close to them.

Answer key for additional questions

1. Low milk yield and problems with composition will occur (mainly milk fat percentage will be variable from pick-up to pick-up). Cows will appear hungry, become restless and wait for feed. Cows will rush to fresh forage, to feed troughs, and into the dairy for grain. Cows will eat all feed allocated in paddocks and troughs. Body condition scores will be low.
2. Some of the factors that affect the water requirement of lactating cow are stress, weather conditions, heat, cold, disease, production state or level of production, exercise, water and salt content of the feed, etc.

9.4. Milk Production and Processing

Learning Competencies

Periods allotted: 2 periods

At the end of this lesson, students will be able to:

- Coordinate milk production
- Understand lactation cycle in dairy cattle production
- Demonstrate milk processing

Contents

- Milk production
- Lactation cycle in dairy production
- Milk processing

Overview

Dairy cattle are primarily adapted to convert feed to a maximum yield with high quality milk. Milk is the primary product of dairying. Milk is the most complete food to the human body at least for children. It is very nutritious. At the same time, milk is the most perishable product. It is highly deteriorated by unfavourable microorganisms. This necessitates the clean milk production, handling, preservation, storage and processing. In this section, we look at milk production and processing as well as the concept of lactation cycle in dairy cattle production.

Teaching-Learning Process

Suggested Instructional Materials

Videos showing milking procedure, hand milking, milking machine, lactation curve, milk processing, etc.

Suggested Teaching Methods

Informal lecture – Demonstration/Practical activity – Video show

Pre-Lesson Preparation

Get ready the instructional materials in advance. Refer to materials that are relevant to the topic you are teaching. Suggest student to read the topic of milk production and processing in their textbook, before facing the actual class discussion.

Prepare relevant videos showing milking procedure and milk processing. Some links are:

- Milking procedures for maximum milk quality: https://youtu.be/mBgon39usbQ?t=13
- The basic steps of milk production: https://youtu.be/7TMtA8Eh9uE?t=8
- Milk pasteurizer for small-scale dairy farm: https://youtu.be/jhMr8UPy5oc?t=51

Presentation of the Lesson

a) Introduction to the lesson

Inform the students on the objectives of the daily lesson. Let the student to share their experience with regard to milk production and processing.

b) Body of the lesson

Discuss milk production in terms of milking system, frequency, interval, duration and order of milking cows. For example, cows which have or suspected of disease or some infection are usually milked last.

Explain sufficiently the concept of lactation cycle in dairy production. This is can better supported with appropriate illustration such as figure 9.8 and figure 9.9. Discuss the profitability of a dairy farm in relation to lactation stage.

Describe the purposes or reasons of milk processing. Milk processing converts raw milk into high-value dairy products (pasteurized liquid milk, cream, yoghurt, butter, cheese and ghee). You can present the flow of milk processing as shown below.

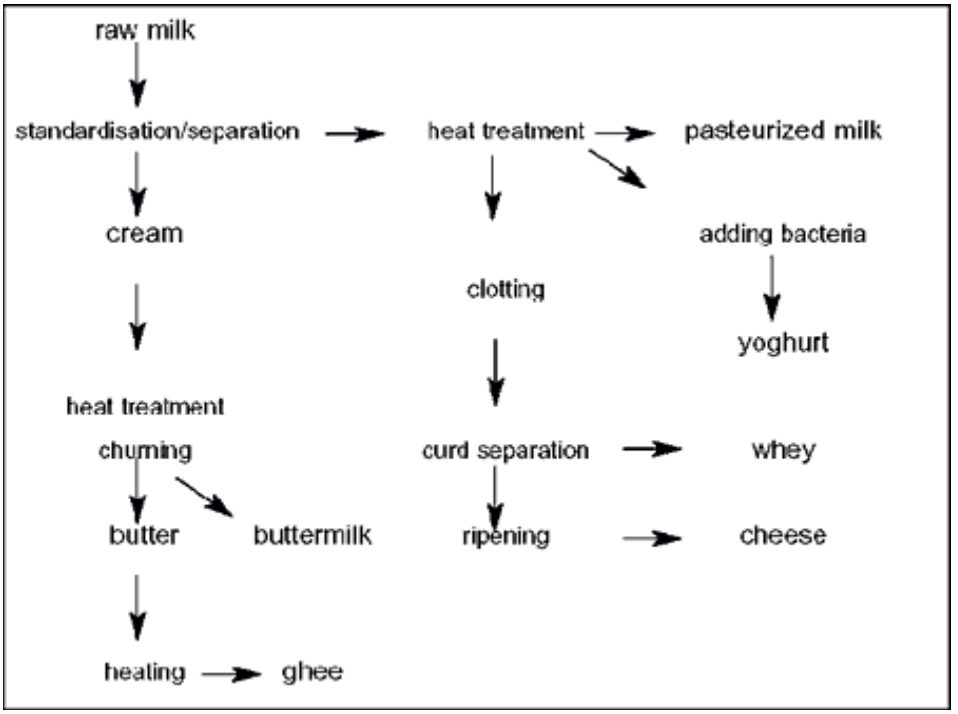


Figure 9.1. Flow scheme for milk processing options (adapted from FAO, 1994)

Help students to understand clearly what they are, and how each of these dairy products are manufactured. You should arrange practical activities (activity 9.5). As much as possible, display the videos arranged for this particular session.

c) Stabilization

Give a short summary of the following points.

- Milk production
- Lactation cycle
- Milk processing

Assessment and Follow-Up

a) Assessment

At the end of the section, check knowledge of students by question and answer.

1. List some examples of pasteurized liquid milk in Ethiopia or your locality.

2. Write the different phases of lactation cycle.
3. Ask students to make presentation on the main points of the videos they see

b) Follow up

To help your students get more knowledge on the topic, you can have them work on topics that are directly related to your lesson. For example, ask them to make notes in their books about the milk production and processing. Student should also complete activity 9.3, 9.4 and 9.5.

c) Additional Questions

1. Why it is important to process milk?
2. Write the suggested milking order of cows. Why it is important?

Answer for Activities and Additional Questions

Activity 9.3

Students in small groups are required to visit a dairy farm in their school or nearby area where they should observe the farming situation with regard to milk production (e.g., milking situation employed, individual cow's milk yield records, breed/s of dairy cattle, adopted milking system, milking time, schedule, milk yield per day, etc.). They should write a short report and present to the whole class. The report should notify the strengths, weakness and their recommendations towards clean milk production. If possible, as a teacher of agriculture, you should invite the corresponding dairy farmers during student's presentation or provide them the report after your modification.

Activity 9.4

You should encourage the whole class to answer the data response questions. These questions are based on the actual figures 9.9. They should comprehend carefully the relationship exist among dry matter intake, milk yield and body condition scores of lactating dairy cow.

Activity 9.5

This is a practical activity. You should subdivide the whole class in to

six groups. Make sure that students with disability or slow learners are considered well or arranged in effective and efficient manner. Each group should take either of the six dairy products as a topic and work on the whole process of manufacturing it. If possible, you are recommended to arrange working environment for the students to accomplish each task practically. This may be in laboratory or at demonstration dairy farm.

Dear Teacher, You can get further information in this video: https://youtu.be/T95j-sI2u9A?t=5

Answer key for additional questions

1. Reasons for milk processing are:
   - processed products attract a higher price
   - increased shelf life of the product
   - reduce bulkiness by removing moisture
   - more distant markets can be accessed
   - processed products are generally easier to transport (lighter/less bulky)
   - increased quality and hygienic safety
   - more flexibility in satisfying consumer demands, (make more or less liquid milk, more cheese, etc.)
   - it creates employment opportunity
2. A suggested milking order is 1). First calf heifers free of mastitis, 2). Older cows free of mastitis, 3). Cows with history of mastitis but not showing the symptoms, 4). Cows with quarters producing abnormal milk. It is important to prevent the cross infection of cows by mastitis.

9.5. Dairy Cattle Housing Management

Period allotted: 1 period

Learning Competencies

At the end of this lesson, students will be able to:

- mention the importance and types of dairy cattle housing
- describe housing requirements for dairy cattle
- describe sanitation and manure management in dairy farm

Content

- Dairy cattle housing management
- Sanitation and manure management in dairy farm

Overview

In this section, the importance of dairy cattle housing, the common types of dairy cattle housing, and also the requirement of housing are described in terms of environmental, space, and sanitation requirements as well as building and equipment arrangements. The sanitation and manure management in dairy farm which contributes to the success of any farm operation presented at the end of the section.

Teaching-Learning Process

Suggested Instructional Materials

Videos showing dairy cattle housing structure, sanitation, manure storage and management, etc.

Suggested Teaching Methods

Brainstorming - Gapped lecture – Field visit and presentation - Digital learning

Pre-Lesson Preparation

Refer to materials that are relevant to the topic you are teaching. Some useful links are:

1. https://vikaspedia.in/agriculture/livestock/cattle-buffalo/housing-for-dairy-cattle
2. https://www.basu.org.in/wp-content/uploads/2020/04/LPM-605-HOUSING_MANAGEMENT_OF_DAIRY_ANIMALS.pptx
3. https://www.researchgate.net/publication/40185098_Housing_and_management_of_dairy_cattle_in_small_scale_farms_of_East_Java_in_Indonesia
4. https://nodpa.com/n/406/Consider-Deep-Pack-Barns-for-Cow-Comfort-And-Manure-Management
5. https://www.youtube.com/watch?v=lSMifC_F9Vs

Presentation of the Lesson

a) Introduction to the lesson

Start this section by allowing students to accomplish brainstorming 9.5 individually. Ask them to write few points they can remember from Unit 7 about cattle housing and their purpose and types.

b) Body of the lesson

Explain to students the need of good housing in milk production.

Tell them the two types of dairy houses that are common. These are the loose housing and the conventional barn.

Describe the housing requirements (environmental, space, and sanitation requirements, building and equipment arrangements, drainage, sloping, floor, etc.). Help students to understand Table 9.3. The floor and trough space requirement of dairy cattle

Discuss the next topic on sanitation and manure management in dairy farm

c) Stabilization

Give a short summary of the following points.

- Purposes and types of dairy cattle housing
- Housing requirements
- Sanitation and manure management in dairy farm

Assessment and Follow-Up

a) Assessment

At the end of the section, check performance of students by question and answer.

1. List the common types of dairy cattle house.
2. Describe the floor and trough space requirement of dairy cattle at various stages?

b) Follow up

Students should complete activity 9.6.

c) Additional Questions

1. Why it is important to have a good dairy cattle house?
2. Why it is important to have sanitation and manure management in dairy farm

Answer for Activities and Additional Questions

Activity 9.6

Students should write the results of their farm visit explaining: the type of cattle housing found there, why farmers chose that specific housing type, reflection of indigenous knowledge, etc. You should check, mark the report and provide them timely feedback.

Answer key for additional questions

1. Good dairy cattle house is important for:
   - proper growth and optimum productivity
   - better profit of the farm
   - controlling diseases and ensuring better health of animals
   - better labour utilization, etc.

2. Good sanitation or good hygiene is a key element in maximizing quantity and quality of milk. This helps to minimize or prevent contamination caused due to entry of pathogens and bacteria from unhygienic milking

procedures, equipment, milk contact surfaces, handlers, storage or packaging conditions. If managed and used properly manure can be a great resource on the dairy farm. It can be used as a natural fertilizer for farm forage production. This helps in reducing feed cost and thereby increase farm profitability margin. Manure also used for biogas production. (https://youmatter.world/en/definition/definitions-biogas-definition-what-is-biogas/)

(9.6, 9.7). Major Disease of Dairy Cattle, and Profitability in Dairy Business

Period allotted: 1 period

Learning Competencies

At the end of this lesson, students will be able to:

- list major diseases and parasites of dairy cattle
- describe the preventative and control measures of diseases and parasites of dairy cattle
- calculate the profitability of dairy business

Contents

- Major disease of dairy cattle and control methods
- Profitability in dairy business

Overview

Good feeding and breeding will not result in maximum production if dairy cows are not kept in good health. The best economic returns are realized when disease problems are kept at a minimum. In this section, the major disease of dairy cattle and their control methods as well as profitability in dairy business are presented.

Teaching-Learning Process

Suggested Instructional Materials

Pictures or photos of dairy cattle diseases and parasites. You need also stick for profitability section.

Suggested Teaching Methods

Brainstorming - Questioning - Gapped lecture - Think-Pair-Share

Pre-Lesson Preparation

Refer to materials that are relevant to the topic you are teaching. Some useful links are:

1. https://www.standardmedia.co.ke/farmkenya/livestock/article/2001339235/common-diseases-affecting-dairy-cattle
2. https://idosi.org/wjdfs/wjdfs14(2)19/2.pdf
3. https://www.sciencedirect.com/science/article/pii/S0022030206721956
4. How to maximize your dairy farm's profit margins: https://www.dairyglobal.net/dairy/milking/how-to-maximise-your-dairy-farms-profit-margins/

Presentation of the Lesson

a) Introduction to the lesson

Start this section by allowing students to accomplish brainstorming 9.5 individually. Try to check their answers against the relevant section in Unit 8.

b) Body of the lesson

Introduce to students the need of maintaining good health in dairy farm. Tell them the common diseases and parasites of dairy cattle in Ethiopia

Describe the general preventive and control measures diseases and parasites of dairy cattle (Table 9.4.). The table shows a summary of common diseases of dairy cattle with their symptoms, routes of transmissions and prevention and control measures.

Discuss the section on profitability in dairy business. Work on the sample example towards calculating profit in dairy farm. Tell them the good management practices that helps farmer to increase the profitability margin from their herd. The interconnection between the key indicators of good management practices and productivity and profitability in dairy

farm should be clearly displayed as shown below

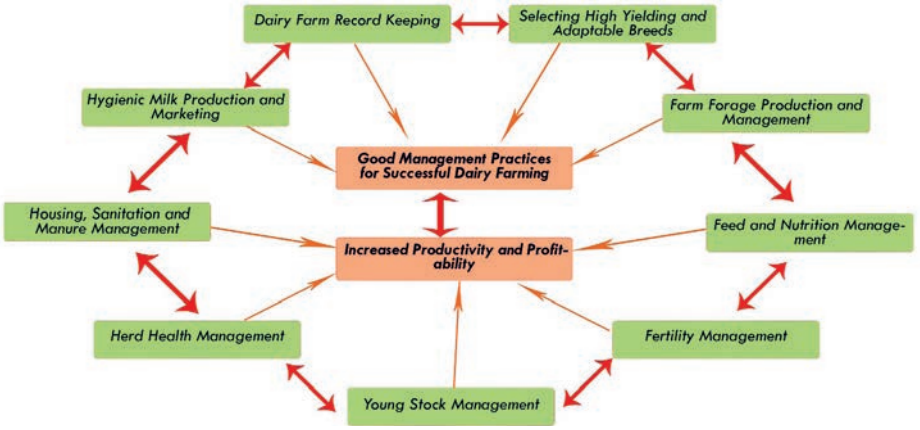


Figure 9.2. A schematic that shows the interconnection between good management practices and profitability in dairy farm

c) Stabilization

Summarize the following points briefly.

- Common diseases and parasites of dairy cattle in Ethiopia
- Preventive and control measures diseases and parasites
- Profitability in dairy business and good management practices

Assessment and Follow-Up

a) Assessment (Use checklist for self-assessment)

At the end of the section, check knowledge of students by question and answer.

1. Ask students to list the most common reproductive diseases of dairy cattle in Ethiopia.
2. Ask students to describe the general preventive and control measures of diseases and parasites of dairy cattle.
3. Ask students to list the good management practices (GMP) that helps farmers to increase the profitability margin from their herd.

b) Follow up

Each student should accomplish activity 9.7. This is class work.

c) Additional Questions

1. Can you write the internal parasites of dairy cattle?
2. Can you write the external parasites of dairy cattle?

Answer for Activities and Additional Questions

Activity 9.7

The most common diseases and parasites of dairy cattle in Ethiopia include blackleg, anthrax, brucellosis, contagious bovine pleuropneumonia (CBPP), dystocia, retention of placenta, vaginal prolapses, bloat, diarrhea, acidosis, ketosis, milk fever, liver fluke, schistosomosis, trichuris, ascaridid, ticks, flee and tsetse flies. The general preventive and control measures diseases and parasites of dairy cattle include good herd management, proper nutrition, housing, vaccinations, biosecurity measures, quarantine system, ensuring clean grazing, instituting a policy of routine drenching, etc.

Answer key for additional questions

1. The internal parasites include liver fluke, schistosomosis, trichuris, ascaridid, etc.
2. External parasites include ticks, flee and tsetse flies.

Answer Key for Review Exercise

Part I

1. A
2. D
3. C
4. B
5. A

Part II

1. Horro, Fogera, Arsi, Barca, Sheko and Boran cattle
2. Breed characteristics of high yielding dairy cows
   - Animal should have wedge shaped appearance of the body
   - It should have bright eyes with lean neck
   - The udder should be well attached to the abdomen
   - The skin of the udder should have a good network of blood vessels

- All four quarters of the udder should be well demarcated with well-placed teats.

3. Lactation

Check List

Check the student's performance according to the given competencies referring the questions under the check list for every unit. Put a tick (√) mark against each task weather they are able to perform in the competencies of each unit. The students are expected to respond saying 'Yes' or 'Partly' or 'No'. Then, you can make your own assessment whether the competencies are met or not.

Check the student's performance against the learning outcomes.

Can you:

		Yes	Partly	No
1	identify different dairy cattle breeds and selection methods? …...…...…….			
2	explain dairy cattle feed resources and feeding methods? ……..….			
3	describe milk production and processing?…			
4	explain about dairy cattle housing management?……			
5	list the major diseases of dairy cattle and control methods?…….			
6	calculate profitability in dairy business? ...			

Unit Assessment

Students' performance has to be assessed continuously over the whole unit. The assessment will be made by comparing students' performance with the specified level of competencies, to determine whether the student has achieved the minimum required level.

A student working at the minimum requirement level will be able to:

- identify different dairy cattle breeds and selection methods
- explain dairy cattle feed resources and feeding methods
- describe milk production and processing
- explain about dairy cattle housing management
- list the major diseases of dairy cattle and control methods
- calculate profitability in dairy business

Students working above the minimum requirement level should be praised and their achievement recognized. They should be encouraged to continue working hard and not become self-satisfied.

Students working below the minimum requirement level will require extra help if they are to catch up the rest of the class. They should be given extra attention in class and additional lesson time during the breaks or at the end of the day

Unit 10 Introduction to Natural Resources

Periods allotted: 6 periods.

Unit Introduction

In this unit, the students will learn about natural resources, their meaning, types, causes and consequences of degradation.

Unit Leaning Outcomes

At the end of this unit, students will be able to:

- define natural resources
- describe natural resources in their areas
- classify natural resources into renewable and non-renewable resources
- explain the importance of natural resources
- describe the causes of natural resource degradations
- explain the consequences of natural resource degradation

10.1 Definition and Importance of Natural Resources

Period allotted: 1 period.

Learning Competencies

At the end of this lesson, students will be able to:

- define natural resources
- describe the importance of natural resources

Contents

- Definition and importance of natural resources

Overview

In this section, the students will learn about the definition and the importance of natural resources.

Teaching-learning Process

Suggested Teaching Methods:

- Brainstorming questions

Presentation of the Lesson

a) Introduction to the lesson - Introduce students to the meaning of natural resources by asking them brainstorming questions

b) Body of the lesson

Start the lesson by:

- explaining what natural resources are and their classification into renewable and non-renewable categories. Give them examples.
- discuss the importance of natural resources by giving examples of the benefits generated from them.

c) Stabilization

Give a summary of:

- how natural resources differ from other resource types and what benefits humans get from them

Assessment

For assessment, you can give students the questions below as class work.

- What natural resources are found in your surroundings?
- How do you classify natural resources? Which ones are renewable and which ones are non-renewable resources?

10.2 Major Types of Natural Resources

Period allotted: 1 period.

Learning Competencies

At the end of this lesson, students will be able to:

- identify the major types of natural resources and their benefits

Contents

- Major types of natural resources

Overview

In this section, the students will learn about the major types of natural resources and their benefits.

Teaching-learning Process

Suggested Teaching Method

- Questioning and answering

Presentation of the Lesson

a) Introduction to the lesson - Introduce students to major types of natural resources by asking them what types of natural resources they know

b) Body of the lesson

Present the lesson by:

- explaining the major types of natural resources (forests, wild life, soils, water)
- discuss about the environmental benefits of each type of natural

resources. Give them examples

c) Stabilization

Give a summary of:

- how the major natural resources benefit the environment and how they relate to one another (Healthy soils support good vegetation growth which enhances the water cycle and so on.)

Assessment

For assessment, you can give students tasks like

- What are the benefits of soils other than supporting plant growth?
- How does water affect soils and forests?

- Ask students to make an observation of soils in their surroundings. Ask them to find out whether the soils are covered by plants the whole year or for what proportion of the year? How does this affect the soil resource?
- Are livestock allowed to graze openly on the soils after crop harvest? How does this affect soils?

Answer to activity 10.1 (suggested approach)

For activity 10.1, students could ask their parents about energy consumption and fill out the following table (question 1)

Activities	Energy source	Firewood use per week (kg of firewood or charcoal for cooking) or other energy source (volume of gasoline for lighting….)
Cooking		
Light for the house		
Ironing clothes		

- Then, depending on their findings, let them discuss the effects of the use of firewood on the existing forest resources
- Let them discuss and suggest what can be done to reduce the negative effects of firewood use on the environment (on forest

cover, water, soil erosion and so on)

10.3 Causes and consequences of Degradation of Natural Resources

Periods allotted: 4 periods.

Learning Competencies

At the end of this lesson, the students will be able to:

- describe degradation of natural resources
- explain the major causes of degradation of natural resources
- explain the consequences of degradation of natural resources

Contents

- Degradation of natural resources, causes and consequences

Overview

In this section, the students will learn about the major concepts related to use and management of natural resources. They will also learn the causes and consequences of degradation of natural resources. Natural resource degradation is any change or disturbance of the environment that causes deterioration, destruction or depletion of resources like soil, forest, water or air resulting in destruction of ecosystems and extinction of wildlife.

Teaching-learning Process

Suggested Teaching Methods

- Brainstorming questions, question and answer, interviews

Presentation of the Lesson

a) Introduction to the lesson -Introduce students to the concept of natural resource degradation by asking them what they think is the meaning of natural resource degradation

b) Body of the lesson

Present the lesson through:

- explaining the meaning of natural resources degradation. Give examples.
- explain about causes and consequences of natural resources

degradation by taking the case of the major natural resources (causes and consequences of degradation of soils, forest, wild life, water and air)

- explaining the interaction between degradation of the major natural resources (the relation between soil degradation and forest degradation and again with wild life degradation)
- finally explain the implication of the degradation of natural resources on agriculture

c) Stabilization

Give a summary of:

- the major causes and consequences of degradation of natural resources
- the interaction between degradation of the major natural resources
- effects of natural resources degradation on agricultural productivity

finally, ask students to discuss the following questions, let them discuss in pairs and share their views with groups sitting next them:

- Describe your personal experience about natural resources degradation in your surroundings.
- Is the problem of natural resource degradation widespread? What do you think are the causes?
- Describe the possible consequences of degradation of these resources in your surroundings.

Assessment

For assessment, you can give students the following questions as homework. Students should produce written answers and their answers should be marked (evaluated).

- What is natural resource degradation.
- What should be done to reduce natural resource degradation. Give 3 suggestions.
- Describe soil degradation processes and the effects on agriculture.
- Which types of soil degradation processes are observed in your surroundings? What do you think is the cause and how can it be reversed?

Answers to activity 10.2, 10.3 and 10.4 (suggested approach)

For activity 10.2, let students complete the following table with the responses they got from the offices of agriculture in their areas.

Soil degradation process	Effect on agriculture	Effects on the environment	Farmers adaptation mechanisms

Students could also visit a local area affected by soil degradation. For this, let them be in groups. Help them to visit a degraded land and report their observations to the class!

Activities 10.3 and 10.4 (suggested approach)

For this activity, students were asked to consult related literature, browse the internet or ask experts in the local bureaus (forestry, mining, natural resources and/ wildlife) or other relevant offices. Encourage students to visit a relevant government office or ask experts or search the literature (including internet, if available). Encourage them to present their findings to their classmates.

Answer Keys to the Review Exercise

Part I. Multiple choice

1. D	3. B	5. B	7. A	9. C
2. D	4. B	6. D	8. A	10. A

Part II. Subjective questions.

1. Ethiopia has a substantial amount of surface and ground water resources including 8 river basins, one Lake Basin and a huge volume of ground water resource. This is why the country is called The Water Tower of the Horn of Africa
2. Crop production is affected by soil properties. The major soil properties that affect crop production are soil ability to store nutrients, water and air, the ease with which the soil allows movement of water and air and the capacity of the soil to allow

healthy root growth.

3. Forests provide firewood, construction material and timber. They are habitats for wildlife. They protect soils against erosion, provide medicines, food, etc.
4. Natural resource management is using the resources in a way that enables us to fulfill our current needs but without compromising the ability of future generations to produce food in obtain other services from natural resources. A proper management of natural resources ensures the sustainability of the resource.
5. Good soil (fertile soil) enhances forest growth. Good forest enhances or facilitates water cycling. A good forest improves soil fertility through adding organic materials. It also protects soils from erosion. This enhances water storage in soils and this results in good plant growth (forest cover) and so on.
6. Soil degradation:
    - reduces abundance of soil organisms
    - increases pollution of water resources
    - causes sediment accumulation in dams
    - reduces carbon storage in soils
    - reduces actual crop yields by reducing the essential nutrients and
    - organic materials required by growing plants. It also makes the soils less suitable for crop production
7. Air is polluted when there is an unusually high concentration of toxic or harmful substances in the atmosphere. Air pollution can cause a serious health damage to humans, livestock and to plants
8. Mineral exploitation generates different kinds of wastes and these wastes can pollute soils, water, soil organisms and even humans when polluted water is consumed

9.

Degradation	Possible solutions
Soil degradation	Improved soil conservation and management
Forest/wildlife degradation	Afforestation, forest conservation and sustainable management, reduce deforestation. Habitat protection reduces human and livestock encroachment into wildlife habitats
Air and water pollution	Controlled waste management, improved management of agricultural chemicals, environmental consciousness

10. Mineral exploitation generates wastes at different stages. These wastes can end up in soils and water bodies resulting in pollution of these resources.

Check List

Check the student's performance against the learning outcomes.

Can you:

		Yes	Partly	No
1	define natural resource degradation? ……			
2	explain the causes and consequences of degradation of the major natural resources? ..			
3	describe the relationship and interaction between degradation of the major natural resources?..……			
4	explain the implications of natural resources degradation on agriculture?…….....			

Unit Assessment

Students' performance has to be assessed continuously over the whole unit. The assessment will be made by comparing students' performance with the specified level of competencies, to determine whether the student has achieved the minimum required level.

A student working at the minimum requirement level will be able to:

- define natural resources as used in the unit
- describe natural resources in their areas
- classify natural resources into renewable and non-renewable resources
- explain the importance of natural resources
- describe the causes of natural resource degradations
- explain the consequences of natural resource degradation

Students working above the minimum requirement level should be praised and their achievement recognized. They should be encouraged to continue working hard and not to become self-satisfied.

Students working below the minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time during the breaks or at the end of the day.

Unit 11 Management of Natural Resources

Periods allotted: 6 periods.

Unit Introduction

In this unit, students will will learn about concepts related to sustainable resource use and the management of the major natural resources.

Unit Learning Outcomes

At the end of this unit, students will be able to:

- explain the major concepts in use of natural resources
- explain soil management
- describe agricultural water management
- state the importance of forest and wildlife management
- explain environmental management
- identify types of indigenous knowledge related to natural resources management practices

11.1 Concepts of Natural Resource Use

Periods allotted: 2 periods.

Learning Competencies

At the end of this lesson, the students will be able to:

- explain the major concepts related to the use of natural resources

Contents

- Concepts of natural resource use

Overview

In this section, the students will learn about the major concepts in relation to the use of natural resources. The discussion will include sustainable use of natural resources and the concept of carrying capacity. Many of the natural resources (particularly the non-renewable ones) that exist in different regions are found only in limited or finite quantities. For example, the amount of coal, natural gas or mineral ores that exist globally is finite and limited. Failure to wisely use natural resources, results in their depletion in a short time. Depleting the amount of natural resources available in our surrounding markedly, affects the fate of future generation. A proper management of natural resources ensures the sustainability of the resource.

Teaching-learning Process

Suggested Teaching Methods

- Brainstorming questions, Question and answer

Presentation of the Lesson

a) Introduction to the lesson-Introduce the students to the meaning of natural resource management by asking brainstorming questions and revising previous lesson on natural resources degradation.

b) Body of the lesson

Present the lesson by:

- explaining natural resource management, and define concept of carrying capacity. Give examples. If the carrying capacity of a

given natural resource is exceeded, it becomes degraded rapidly.

- explain about sustainable use of natural resource (the issue of sustainable use is especially important in the case of exhaustible resources)
- explain that sustainable use of natural resources relates to not exceeding the carrying capacity of the resource and not compromising the fate of the generations coming after us.

c) Stabilization

Give a summary of:

- what sustainable resource use is and how it affects degradation of resources

Assessment

For assessment, you can give students the questions below as class work.

- Describe the management of natural resources in your surroundings.
- Are these management practices sustainable? If not, what needs to be done to improve the sustainability?

11.2 Soil management

Period allotted: 1 period.

Learning Competencies

At the end of this lesson, students will be able to:

- explain what soil management is

Contents

- Soil management

Overview

In this section, students will learn about soil management. They have learned what soil degradation is and the different processes of degradation. Here, they will learn how soils can be managed to reduce soil degradation and the associated consequences.

Teaching-learning Process

Suggested Teaching Methods

- Brainstorming

Presentation of the Lesson

a) Introduction to the lesson - Introduce students to soil management by asking brainstorming questions

b) Body of the lesson

Taking students' background understanding into consideration, commence your presentation by:

- explaining the major soil degradation processes and their consequences (as revision of previous unit)
- explain importance of soil management and discuss examples of soil management practices used to reduce soil degradation by taking agronomic measures like mulching and contour cropping as examples
- explain soil fertility improvement as one way of soil management to reduce soil degradation

c) Stabilization

Give a summary on

- how soil management practices can reduce problems of soil degradation and how this affects crop yields

Assessment

For assessment, you can give students the following questions as home work. Students need to produce written answers which should be marked (graded).

- What are the major soil management practices used in Ethiopia?
- Which of these management practices are common in your surroundings?
- Are these management practices bringing observable changes in the resources? If so, how?

11.3 Agricultural Water Management

11.4 Forest and Wildlife Management

Period allotted: 1 period.

Learning Competencies

At the end of this lesson, students will be able to:

- describe agricultural water management and
- explain forest and wildlife management

Contents

- Agricultural water management
- Forest and wildlife management

Overview

In this section, students will learn about agricultural water management. Agriculture is the major user of water resources and the way we manage agricultural water directly affects agriculture. So, agricultural water management is critical for rain fed as well as irrigation based agriculture. Students will also learn about the meaning and importance of forest and wildlife management.

Teaching-learning Process

Suggested Teaching Methods

- Brainstorming questions, question and answer

Presentation of the Lesson

a) Introduction to the lesson - Introduce students to agricultural water management and forest and wildlife management by asking brainstorming questions

b) Body of the lesson

Present the lesson by:

- explaining how water affects agriculture, particularly in areas totally dependent on rainfall for agriculture

- explain why water management is needed in rain fed agricultural systems
- explain agricultural water management by giving examples of specific water management practices that are used to increase water availability in agriculture
- explaining the major objectives of forest and wildlife maintenance and improvement by citing the different benefits that these resources provide
- explain what forest management is, its objectives and what types of practices it includes

c) Stabilization

Give a summary of

- the major objective of agricultural water management and how this affects agriculture
- how forest and wildlife management are interrelated

Assessment

For assessment, you can give students questions below as home work.

- What agricultural water management practices are used in your localities?
- How is forest being managed in your surroundings? What needs to change for better forest management?
- What wildlife resources are found in your surroundings? How are they being managed?

11.5 Environmental Management

Period allotted: 1 period.

Learning Competencies

At the end of this lesson, students will be able to:

- describe environmental management

Contents

- Environmental management

Overview

In this section, students will learn about the meaning and importance of environmental management.

Teaching-learning Process

Suggested Teaching Methods

- Brainstorming, question and answer, interviews

Presentation of the Lesson

a) Introduction to the lesson - Introduce students to environmental management by asking brainstorming questions for example what they think is environmental management and what it includes.

b) Body of the lesson

Present the lesson by:

- explaining the meaning of the environment and how humans interact with it
- then, explain what environmental management is and its major goals and objectives
- finally, explain about major environmental management practices

c) Stabilization

Give a summary of

- how environmental management affects other natural resources management (soils, water, forest and wildlife).

Assessment

For assessment, you can give students the questions below as class work.

- What are the major components of environmental management?
- What environmental management practices are implemented in your surroundings? Are these management practices effective? If so, how?

11.6. Indigenous Knowledge Applicable in Natural Resources Management

Period allotted: 1 period.

Learning Competencies

At the end of this lesson, students will be able to:

- Identify types of indigenous knowledge applicable to natural resources management practices

Contents

- Indigenous knowledge applicable in natural resource management

Overview

In this section, students will learn about some indigenous knowledge practices used in natural resource management. These practices relate to conservation of soils, water, forests and wildlife resources by using locally developed knowledge.

Teaching-learning Process

Suggested Teaching Methods

- Brainstorming

Presentation of the Lesson

a) Introduction to the lesson - Introduce students to indigenous knowledge applicable in natural resource management by asking brainstorming questions

b) Body of the lesson

Present the lesson by:

- explaining what indigenous knowledge is and give example of such knowledge used in natural resource conservation (for example, the use of wild medicinal plants has resulted in their conservation in different regions)
- discuss the different indigenous practices in different regions of the country used in natural resource conservation, particularly soils, forests and wildlife
- explain about the wildlife degradation by giving examples and describe about what could be done to reduce wildlife degradation

c) Stabilization

Give a summary of:

- how indigenous knowledge practices contribute to improved soil, water, forest and wildlife conservation and management

Assessment

For assessment, you can give the following questions as home work.

- Which indigenous knowledge practices are used in natural resource conservation in your surroundings?
- How do these practices contribute to improved agricultural productivity?

Answer for activity 11.1 (suggested approach)

For answering this activity, students can find information from government offices or from elders about the available water and forest resources in their areas. The following table could help in compiling the information. They can share the information with the whole class after compiling.

Type of resource	Type of management used	Indigenous knowledge used in management	Remark (extent of indigenous knowledge use)
Water resources			
1.			
2.			
3.			
Forest resources			
1.			
2.			
3.			

Answer Key to Review Exercises

Part I. Multiple choice

1. D 2. C 3. C 4. A 5. C

Part II.

1. Increasing water availability is vital to improve agricultural productivity. Agricultural water management aims to improve availability of water for agricultural use. In the absence of these practices, especially in rain fed areas, crops will be affected by water shortage and that causes a decline in yields.
2. Find this out from bureau of agriculture, or from elders and local farmers
3. Forest provides habitat for different wildlife species. The major factor for wildlife degradation is habitat destruction. So, conserving the forest will have a positive effect on wildlife conservation.
4. The principal objective in soil management is to reduce the different processes of soil degradation including soil erosion, compaction, acidity, salinity and other forms of soil degradation.
5. The major problems for wildlife management in Ethiopia are habitat destruction in the form of deforestation, human and livestock encroachment into wildlife habitats, forest fires and illegal hunting.
6. The Konso soil conservation practice and the Gumuz indigenous

natural resource management system

7. One of the major roles of soils is its use as a medium of plant growth. A good soil (well managed soil) supports growth of trees and hence good forest cover. A good forest cover provides habitat for wildlife species. On the other hand, the forest improves soil fertility through addition of organic materials from falling leaves, branches and roots. Besides, the forest protects soil from erosion. A fertile soil further enhances growth of trees and other plants, improving the forest cover, which again provides habitat for wildlife.
8. One of the principal objectives of environmental management is to prevent the release of harmful substances into the environment including the atmospheric air. These harmful substances include greenhouse gases (CO_2, CH_4 and N_2O) that cause global climate change. So, poor environmental management can increase the release of these gases into the atmosphere and enhance climate change, whereas a good environmental management reduces their release into the atmosphere. So, environmental management is directly related to climate change.

Check List

Check the student's performance against learning outcomes

Can you:

		Yes	Partly	No
1	Explain sustainable use of natural resources?			
2	explain soil management? ..…….			
3	describe agricultural water management?….			
4	state the importance of forest and wildlife management? ……..….....			
5	explain environmental management? ……			
6	explain climate change and adaptation practices? …			
7	identify types of indigenous knowledge applicable to natural resources management practices?…….			

Unit Assessment

Students' performance has to be assessed continuously over the whole unit. The assessment will be made by comparing students' performance with the specified level of competencies, to determine whether the student has achieved the minimum required level.

A student working at the minimum requirement level will be able to:

- explain sustainable use of natural resources,
- explain soil management,
- describe agricultural water management,
- state the importance of forest and wildlife management,
- explain environmental management, and
- identify types of indigenous knowledge applicable to natural resources management practices.

Students working above the minimum requirement level should be praised and their achievement recognized. They should be encouraged to continue working hard and not become self-satisfied.

Students working below the minimum requirement level will require extra help if they are to catch up the rest of the class. They should be given extra attention in class and additional lesson time during the breaks or at the end of the day.

Unit 12 Concepts of Biodiversity

Periods allotted: 5 periods.

Unit Introduction

In this unit, students will learn about biodiversity, its values and services, major threats and the status of biodiversity in Ethiopia.

Unit Learning Outcomes

At the end of this unit, students will be able to:

- define biodiversity
- explain values and services of biodiversity
- identify threats to biodiversity
- describe forest and wildlife management
- explain biodiversity conservation
- provide scientific arguments on the status of biodiversity conservation in Ethiopia

(12.1,12.2.) Biodiversity and its scope

Period allotted: 1 period.

Learning Competencies

At the end of this lesson, students will be able to:

- define biodiversity
- understand the scope of biodiversity

Contents

- What is biodiversity?
- The scope of biodiversity

Overview

In this section, students will learn about the definition and scope of biodiversity.

Teaching-learning Process

Suggested Teaching Methods:

- Brainstorming questions, question and answer

Presentation of the Lesson

a) Introduction to the lesson - Introduce students to the meaning of biodiversity by asking brainstorming questions

b) Body of the lesson

Present the lesson by:

- explaining what biodiversity is and its components (population, species diversity, diversity of habitats)
- explaining the concept of biodiversity by taking Ethiopia as an example to show how habitat diversity relates to diversity of animals, plants and other organisms
- finally explain the scope of biodiversity

c) Stabilization

Give a summary of

- how biodiversity relates to the diversity of animals, plants, organisms and habitats in an area and summarize its scope

Assessment

For assessment, you can give students the following questions as home work. Students should produce written answers and their answers have to be marked (graded).

- What do we mean when we say biodiversity of an area is rich?
- What do we mean by plant biodiversity and animal biodiversity?
- What do we mean by scope of biodiversity?

12.3 Values and services of biodiversity

Period allotted: 1 period.

Learning Competencies

At the end of this lesson, students will be able to:

- explain values and services of biodiversity

Contents

- Values and services of biodiversity

Overview

In this section, students will learn about the major values and services provided by biodiversity. Students will learn about the food and non-food (medicines, timber, firewood and so on) production services, regulatory and cultural services provided by biodiversity to humans and the environment.

Teaching-learning Process

Suggested Teaching Methods

- Brainstorming questions, question and answer, interviews

Presentation of the Lesson

a) Introduction to the lesson - Introduce students to values and services of biodiversity by asking brainstorming questions

b) Body of the lesson

Present the lesson by:

- explaining about production services provided by biodiversity including food production and non-food production
- explain about regulatory services provided by biodiversity by giving examples (climate regulation, pest and disease control, water purification, soil erosion control and waste decomposition among others)
- also explain cultural values and services provided by biodiversity by giving examples (education and research, foreign currency earning, recreational services)

c) Stabilization

Give a summary of

- the various values and services provided by biodiversity that stress the importance of biodiversity to the environment and human livelihood

Assessment

For assessment, you can give students the following questions as classwork. Students should produce written answers, which should be marked (graded).

- What are the major services that you get from biodiversity in your surroundings? Give examples.
- Which of these services are directly linked with your daily life?

12.4 Threats to biodiversity

Periods allotted: 2 periods.

Learning Competencies

At the end of this lesson, students will be able to:

- explain the major threats to biodiversity

Contents

- Threats to biodiversity

Overview

In this section, students will about the major threats to biodiversity.

Teaching-learning Process

Suggested Teaching Methods

- Brainstorming questions

Presentation of the Lesson

a) Introduction to the lesson - Introduce students to threats to biodiversity by asking brainstorming questions

b) Body of the lesson

Present the lesson by:

- explaining about the general sources of threats for biodiversity (habitat destruction, unwise resource use, pollution, population growth and invasive species)
- explain habitat destruction as a threat to biodiversity by giving examples and discussing the major reasons for habitat destruction
- also explain the meaning of unsustainable resource use and how it results in biodiversity degradation
- explain invasive species as a threat to biodiversity by giving examples relevant to the Ethiopian context (Prosopis juliflora, 'Emboch' (Water hyacinth) and parthenium weed)
- also explain climate change, pollution and population growth as

biodiversity threats and how they cause biodiversity degradation

c) Stabilization

Give a summary of

- the major threats to biodiversity mainly relate to human activities

Assessment

For assessment, you can give students tasks like

- What are the major biodiversity resources in your surroundings?
- What are the major threats to these resources?
- Are these threats being addressed by the government or other concerned bodies?
- Are these efforts enough? If not, what more has to be done?

12.5 Biodiversity conservation and the status of conservation in Ethiopia

Periods allotted: 1 periods.

Learning Competencies

At the end of this lesson, students will be able to:

- describe biodiversity conservation and its status in Ethiopia

Contents

- Biodiversity conservation and the status of conservation in Ethiopia

Overview

In this section, students will learn about biodiversity conservation and its status in Ethiopia.

Teaching-learning Process

Suggested Teaching Methods

- Brainstorming questions, question and answer

Presentation of the Lesson

a) Introduction to the lesson - Introduce students to biodiversity conservation and its status in Ethiopia by asking brainstorming questions

b) Body of the lesson

Present the lesson by:

- explaining about the meaning and objectives of biodiversity conservation
- explain why biodiversity conservation is needed in the Ethiopian context
- also explain the major biodiversity resources in Ethiopia by giving examples from the different biodiversity resources of the country
- discuss the major threats to biodiversity resources in Ethiopia by giving examples of practices causing biodiversity degradation and examples of endangered species of the country
- explain some of the efforts being made to improve the biodiversity conservation status in the country

c) Stabilization

Give a summary on:

- the importance and the need for biodiversity conservation
- the major threat to biodiversity resources in Ethiopia and the efforts being made to improve biodiversity conservation

Assessment

For assessment, you can give students the following questions as homework. Students should produce written answers, which should be marked (graded).

- Which biodiversity resources are found in your surroundings?
- Are there conservation practices implemented to maintain these resources? If so, what type of conservation practices are implemented?
- How do biodiversity conservation practices affect the national economy? Give examples.

Answers to activities 12.1 and 12.2 (suggested approach)

For answering activity 12.1, students could select 2 national parks and fill out the following table based on the information they get by asking experts or from the literature including the internet (if available).

National park name	Unique plant species	Unique animal species	Plant Species endangered and in need of conservation	Animal species endangered and in need of conservation
1				
2				

For answering activity 12.2, students could get information from experts, elders or from the literature in school library and prepare a report of their findings. (The general trend is that plant and animal diversity have significantly declined over the last decades students are expected to suggest measures that could change this trend).

Answer Key to Review Exercise

Part I. Multiple choice.

1. C
2. D
3. D
4. C
5. D

Part II.

1. The major components of biodiversity are number of species (plants, animals and other organisms), genetic diversity of different species in an area, population of each species of plants, animals and other organisms, and habitat diversity.
2. Students shall list biodiversity resources (plants, animals, other organisms, habitats) in their surroundings and possible benefits obtained from these resources.
3. Production of food and non-food items, regulatory and cultural services are obtained from biodiversity. If biodiversity does not provide the food production service, for example, humans cannot survive. Also, water purification, climate regulation and other regulatory services

directly affect human livelihood.

4. The major threats to biodiversity include habitat destruction, unwise resource use, invasive species, pollution, climate change and population growth. In Ethiopia, habitat destruction from unwise resource use, invasive species, population growth (both livestock and human) and climate change are the major threats to biodiversity.
5. Invasive species are usually species introduced to an area from somewhere else and compete for resources and habitats with local species. Examples of invasive species in Ethiopia are parthenium weed, Prosopis juliflora and water hyacinth ('Emboch'). These species over compete local species for resources and habitat and could cause disappearance of local species.
   - If biodiversity is conserved, it could contribute to food production and help in achieving food security. Besides, biodiversity also provides non-food production services including timber, medicinal plants and other products that could generate income. Moreover, biodiversity provides cultural services including recreation, education and research and tourism. These could generate a lot of income for the country.

Check List

Check the student's performance against the learning outcomes.

Can you:

		Yes	Partly	No
1	define biodiversity?			
2	explain values and services of biodiversity?			
3	describe forest and wildlife management?			
4	discuss biodiversity conservation?			
5	give informed opinion on the status of biodiversity conservation in Ethiopia?			

Unit Assessment

Students' performance has to be assessed continuously over the whole unit. The assessment will be made by comparing students' performance with the specified level of competencies, to determine whether the student has achieved the minimum required level.

A student working at the minimum requirement level will be able to:

- define biodiversity and its scope,
- explain values and services of biodiversity,
- list threats to biodiversity,
- describe forest and wildlife management,
- discuss biodiversity conservation and
- give informed opinion on the status of biodiversity conservation in Ethiopia.

Students working above the minimum requirement level should be praised and their achievement recognized. They should be encouraged to continue working hard and not become self-satisfied.

Students working below the minimum requirement level will require extra help if they are to catch up the rest of the class. They should be given extra attention in class and additional lesson time during the breaks or at the end of the day.

Unit 13 Climate Change Adaptation and Mitigation

Periods allotted: 5 periods.

Unit Introduction

In this unit, students will learn about climate variability, climate change and adaptation and mitigation strategies used to address problems of climate change.

Learning Outcomes

At the end of this unit, students will be able to:

- describe climate change and variability
- clarify the effects of climate change
- explain climate mitigation and adaptation
- describe climate change mitigation strategies
- explain climate change adaptation strategies of Ethiopia
- explain climate smart agriculture
- mention indigenous knowledge in climate change mitigation practices

13.1 Definition of climate change and its variability

Period allotted: 1 period

Learning Competencies

At the end of this lesson, students will be able to:

- describe climate change and climate variability

Contents

- Definition of climate change and its variability

Overview

In this section, students will learn about the definition of climate change and climate variability. Climate change, as opposed to climate variability, refers to long term change in climate patterns. Climate variability is about short term fluctuations in the climate.

Teaching-learning Process

Suggested Teaching Methods:

- Brainstorming questions

Presentation of the Lesson

a) Introduction to the lesson - Introduce students to the meaning of climate change and climate variability by asking brainstorming questions

b) Body of the lesson

Present the lesson by:

- explaining what climate change means and its consequences to ecosystems
- then, explain climate variability and its difference with climate change by giving example (climate change fundamentally changes ecosystems while climate variability does not)
- explain about causes of climate change and discuss the mechanism by which greenhouse gases cause climate change

c) Stabilization

Give a summary on

- climate change meaning, causes and difference with climate variability

Assessment

For assessment, you can give students the following questions as class work (students should produce written answers and their answers should be marked (evaluated).

- Do you think there is climate change in your locality? What are your evidences (indicators)?
- How do you differentiate climate variability from climate change?

13.2 Climate change and its effects

Period allotted: 1 period

Learning Competencies

At the end of this lesson, students will be able to:

- describe climate change and its effects

Contents

- Climate change and its effects

Overview

In this section, students will learn about climate change and its effects. They will learn the effects of climate change on agriculture and forestry sectors, on oceans and on sea level.

Teaching-learning Process

Suggested Teaching Methods

- Brainstorming questions

Presentation of the Lesson

a) Introduction to the lesson - Introduce students to the concept of climate change and its effects by asking brainstorming questions

b) Body of the lesson

Present the lesson by:

- explaining climate change generally changes rainfall amounts and patterns, global temperatures, sea level rise and drought occurrence
- then, explain effects of climate change on agriculture and forestry sectors by giving examples (for example, climate change will increase rainfall in some regions and drought increases in other regions. In both cases crop production is expected to decrease because when there is high rainfall, soil erosion will increase and that reduces soil fertility and finally crop yields. When there is drought, crop plants will suffer from water shortage and yields will be reduced). Climate change also influences occurrence of crop diseases and pests, which affects crop yields.
- then, explain effects of climate change on sea level rise and ocean acidification

c) Stabilization

Give a summary on

- the major effects of climate change on agriculture and forestry, sea level and oceans

Assessment

For assessment, you can give students tasks like

- Do you think climate change has affected communities in your localities? If so, how?
- Are there efforts made to reverse the effect of climate change? If so, list some of them.

13.3 Climate change mitigating strategies

Period allotted: 1 period

Learning Competencies

At the end of this lesson, students will be able to:

- explain climate change mitigation strategies

Contents

- Strategies of mitigating climate change

Overview

In this section, students will learn about climate change mitigation strategies. They will also learn some of the major mitigation strategies of climate change.

Teaching-learning Process

Suggested Teaching Methods

- Brainstorming questions, question and answer, interviews

Presentation of the Lesson

a) Introduction to the lesson - Introduce students to the concept of climate mitigation by asking brainstorming questions

b) Body of the lesson

Present the lesson by:

- explaining the meaning of climate mitigation and the major mechanisms by which climate change is mitigated.
- then, explain these mechanisms by first discussing ways of reducing greenhouse gas emissions from different sources (sectors).
- then, explain about the second way of mitigation of climate change (enhancing greenhouse gas sinks or storages) by giving examples of practices that enhance greenhouse gas storage (sinks). For example, afforestation helps to store a large amount of carbon in biomass and in below ground parts of trees and hence prevents (reduces) the emission of carbon to the atmosphere. Improved

soil management also helps to improve carbon storage in soils and prevent or reduce its emission to the atmosphere.

c) Stabilization

Give a summary on

- the major mechanisms of climate change mitigation
- some of the major practices that can mitigate climate change

Assessment

For assessment, you can give students tasks like

- What is climate mitigation?
- Have you observed climate mitigation practices implemented in your surroundings? If so, which ones?

13.4 An overview of climate change adaptation strategies in Ethiopia

Learning Competencies Period allotted: 1 period

At the end of this lesson, students will be able to:

- describe climate change adaptation strategies of Ethiopia

Contents

- An overview of climate change adaptation strategies of Ethiopia

Overview

In this section, students will learn about the meaning of climate adaptation and some of the major climate change adaptation strategies used in Ethiopian agriculture.

Teaching-learning Process

Suggested Teaching Methods

- Brainstorming questions, question and answer, interviews

Presentation of the Lesson

a) Introduction to the lesson - Introduce students to the concept of climate adaptation, adaptation practices used in Ethiopia and Climate Smart Agriculture by asking brainstorming questions.

b) Body of the lesson

Present the lesson by:

- explaining what climate adaptation is discussing its difference with climate mitigation (climate mitigation aims at reducing or preventing climate change but climate adaptation is an adjustment that we make to reduce problems caused by climate change after climate change has happened or is expected to happen).
- then, explain some of the major climate adaptation practices used or could be in Ethiopian agriculture to respond to the changing climate by giving examples.
- explain the concept of Climate Smart Agriculture, its objectives and some of the common practices that are included in Climate Smart Agricultural approach. Explain that Climate Smart Agriculture refers to a set of practices some of which contribute to increasing productivity, other practices contribute to climate adaptation and reduction of greenhouse gas emission from agriculture (mitigation). Usually a single agricultural practice does not contribute to all three objectives in CSA. So combining different practices is important in order to achieve the three objectives of CSA.

c) Stabilization

Give a summary on:

- the major climate adaptation practices in Ethiopian agriculture and how these practices help in climate adaptation. Climate Smart Agriculture and examples of practices which qualify as Climate Smart.

Assessment

For assessment, you can give students questions below as home work.

Students have to produce written answers and share their answers with their classmates.

- Which climate adaptation practices are used in agriculture in your localities?
- Are these practices effective in reducing the effects of climate change? If so, how?
- How do you differentiate climate mitigation and climate adaptation? Give examples of practices from each.
- Explain Climate Smart Agricultural practices used in your localities.

13.5 Indigenous knowledge in climate change mitigation strategies

Period allotted: 1 period.

Learning Competencies

At the end of this lesson, students will be able to:

- mention the indigenous knowledge used as climate change mitigation strategies

Contents

- Indigenous knowledge in climate change mitigation strategies

Overview

In this section, students will learn about some indigenous knowledge practices used in climate change mitigation strategies.

Teaching-learning Process

Suggested Teaching Methods

- Brainstorming questions, question and answer, interviews

Presentation of the Lesson

a) Introduction to the lesson - Introduce students to indigenous knowledge used in climate change mitigation by asking brainstorming questions.

b) Body of the lesson

Present the lesson by:

- explaining some examples of indigenous knowledge practices that can mitigate climate change by discussing the mechanisms by which these practices mitigate climate change.
- then, explain that these indigenous practices enhance the storage of carbon in forest and in soils, preventing or reducing emission of carbon to the atmosphere, hence an important climate mitigation impact.

c) Stabilization

Give a brief summary on

- the major indigenous practices with climate mitigation impact.

Assessment

For assessment, you can give students the following questions as homework assignment. Students should produce written answers and share their answers with their classmates.

- Are there indigenous practices that used to mitigate climate change in your localities? If so, what are they?
- Are these practices making a difference in reducing problems of climate change? How?

Answer to activity 13.1 (suggested approach)

For answering these activity, students can search for information from elders, farmers or their parents. Once, they have the information, they can fill the following table and share their findings with their class mates.

Total number of respondents (farmers, elders or parents)	Percentage of respondents who think there is no climate change	Percentage of respondents who think that there is climate change	Indicators used to claim that there is climate change	What practices are used to address these changes (to reduce problems resulting from climate change)

Answer Key to Review Exercise

Part I. Multiple choice.

1. B
2. C
3. A
4. D
5. D

Part II.

1. Climate variability refers to short term fluctuation in climate whereas climate change refers to long term changes in climate patterns. Besides, climate change causes fundamental changes in ecosystems whereas climate variability does not.
2. One of the consequences of climate change is global warming and reduction in rainfall in some regions. When global temperatures increase, water loss through evaporation increases and both crops and animals will face water shortage which reduces productivity in both.
   - Increased temperatures usually favor the occurrence of some pests and diseases that reduce productivity of both animals and crops.
   - Climate change can also cause increased rainfall in some areas. This can cause increased soil erosion, reduces soil fertility. This reduces growth of crops and animal feeds, reducing the yield of both crops and animals.
3. Students shall list their personal observations which they think are related with climate change.
4. Climate mitigation aims at reducing or preventing climate change but

climate adaptation is an adjustment that we make to reduce problems caused by climate change after climate change has happened or is expected to happen.

5. The Gumuz indigenous natural resource management system and the Konso indigenous soil and water conservation method are good examples of indigenous practices used to mitigate or adapt to climate change.

Check List

Check the student's performance against the learning outcomes.

Can you:

		Yes	Partly	No
1	describe climate change and variability?			
2	clarify the effects of climate change?……			
3	suggest climate change mitigation strategies?			
4	explain climate change adaptation strategies of Ethiopia?.....			
5	Explain Climate Smart Agriculture……			
6	mention indigenous knowledge in climate change mitigation practices? ….....			

Unit Assessment

Students' performance has to be assessed continuously over the whole unit. The assessment will be made by comparing students' performance with the specified level of competencies, to determine whether the student has achieved the minimum required level.

A student working at the minimum requirement level will be able to:

- describe climate change and variability,
- clarify the effects of climate change,
- suggest climate change mitigation strategies,
- explain climate change adaptation strategies of Ethiopia,
- explain the concept of Climate Smart Agriculture
- mention indigenous knowledge in climate change mitigation practices

Students working above the minimum requirement level should be praised and their achievement recognized. They should be encouraged to continue working hard and not become self-satisfied.

Students working below the minimum requirement level will require extra help if they are to catch up the rest of the class. They should be given extra attention in class and additional lesson time during the breaks or at the end of the day.

_____

_____

_____

Unit 14 Mechanized Farming

Periods allotted: 3 periods

Unit Introduction

In this unit, the students are introduced to the concept of mechanized farming. The unit addresses definition of farm mechanization, its advantages and disadvantages, as well as the types and uses of common farm tools and equipment employed for plant and livestock farming.

Learning Outcomes

At the end of this unit, students will be able to:

- define mechanized farming
- classify farm tools and equipment
- explain uses of some farm tools and equipment

14.1. Introduction to Mechanized Farming

Period allotted: 1 period

Learning Competencies

At the end of this section, the students will be able to:

- describe mechanized farming

Contents

- Introduction to mechanized farming
- Advantages and disadvantages of farm mechanization
- Levels of mechanization

Overview

In this section, mechanized farming or mechanized agriculture will be defined. In addition, the advantages, disadvantages and levels of farm mechanization are described in the section.

Teaching-Learning Process

Suggested Instructional Materials

Pictures, diagrams, photographs, films, etc. that of mechanized farming.

Suggested Teaching Methods

Brainstorming - Questioning – Gapped lecture – Group work

Pre-Lesson Preparation

Before starting teaching this section, make the Suggested Instructional Materials for the topic ready. Read the textbook and other relevant reference materials on the topic.

Presentation of the Lesson

a) Introduction to the lesson

Brainstorm the students to assess their background knowledge of the topic. During the brainstorming, ask them if they have ever seen any

mechanized farming. Ask them also what they know about the advantages and disadvantages of mechanized agriculture, etc.

b) Body of the lesson

Define mechanized farming or mechanized agriculture

Tell them the advantages and disadvantages of farm mechanization

Describe the levels of mechanization and the three power sources

c) Stabilization

Give a summary of the following points.

- Advantages and disadvantages of farm mechanization
- Levels of mechanization

Assessment and Follow-Up

a) Assessment

At the end of the section, make sure that your students have understood the essential concepts of the lesson by asking them questions and giving them tasks like the following.

1. Define mechanized farming.
2. Why is it important to use mechanization in agriculture?
3. What are the disadvantages of mechanization?

b) Follow up

1. Write the main power sources that are involved in levels of mechanization.

c) Additional Question

1. Describe the three levels of mechanization.

Answer to Activities and Additional Questions

Answers to additional question

1. The three levels of mechanization are

   a) Low level mechanization: manual power used exceeds 33%.

b) Fair level mechanization: animal power used is 34 – 66%.

c) High level mechanization: mechanical power used is 67 – 100%.

(14.2, 14.3). Types and Uses of Farm Tools and Equipment

Periods allotted: 2 periods

Learning Competencies

At the end of this section, the students will be able to:

- classify farm tools and equipment
- explain uses of some farm tools and equipment

Contents

- Types of farm tools and equipment
- Uses of some farm tools and equipment

Overview

A wide range of agricultural equipment is used in mechanized farms. This ranges from the biggest combiners to a hypodermic syringe for animal health. Mechanized farm implements can be divided into several categories, based on their functions. This is the focus of this section. The uses of some farm tools and equipment are also explained

Teaching-Learning Process

Suggested Instructional Materials

Pictures, diagrams, photographs, films, etc. that show farm tools, implements and equipment. See if your school can borrow farm equipment from the nearby agriculture office or from a private source for demonstration.

Suggested Teaching Methods

Questioning - Digital learning – Guest speaker - Group work

Pre-Lesson preparation

Before starting teaching this section, make the Suggested Instructional Materials for the topic ready. Read the textbook and other relevant reference materials on the topic.

Presentation of the Lesson

a) Introduction to the lesson

Start the section by revising the previous lesson. Ask students to list down the main points of the last class. Create a link between the previous lesson and the new one.

b) Body of the lesson

Explain the types of farm tools and equipment. Farm tools and equipment are categorized based on their functions. Give examples of each category.

If you can, invite guests from the pertinent office to describe the uses of some farm tools and equipment such as a tractor, a combine harvester, etc.

c) Stabilization

Give a summary of the following points.

- Categories of farm tools and equipment
- Uses of some farm tools and equipment

Assessment and Follow-Up

a) Assessment

At the end of the section, make sure that your students have understood the essential concepts of the lesson by asking them questions and giving them tasks like the following.

1. List some examples of dairy machineries.
2. Write some functions of a tractor or of any other farm equipment you know.

b) Follow up

1. Write the names and functions of five farm tools and equipment.

c) Additional Question

1. Describe the functions of three dairy machineries.

Answers to Activity and Additional Question

Activity 14.1.

Students in small groups should write the results of their mechanized farm/ school library visit explaining: the list of farm tools and equipment found there, and the functions of each tool and equipment. Good to check their work and give them feedback.

Answers to additional question

1. Three dairy machineries and their functions

   a) Milking machine: To collect or harvest milk

   b) Cooler: To preserve milk at low temperature (≤4°C)

   c) Churner: To make butter from fermented milk or cream

4. Answers Key to Review Exercise

Part I

1. C
2. A
3. B
4. D
5. C

Part II

1. The three levels of mechanization are low, fair and high. The three main sources are animal, mechanical and human power.
2. The advantages of mechanized farming

   - It saves time as large areas of farm land can be prepared in a very short time
   - It reduces the difficulty in farming and saves labour
   - It reduces farm health hazards
   - It encourages a large scale farming and increases in-farm output and income
   - It promotes farmers' co-operation

Check List

Check the student's performance according to the given competencies.

Refer to the questions in the check list for every unit. Put a tick (√) mark against each task to see whether they are able to perform in the competencies of each unit. The students are expected to respond saying 'Yes' or 'Partly' or 'No'. Based on this, make your own assessment and decide whether the competencies are met or not.

Check the student's performance against the learning outcomes.

Can you:

		Yes	Partly	No
1	efine mechanized farming?……			
2	classify farm tools and equipment?..……			
3	explain the uses of some farm tools and equipment?			

Unit Assessment

Students' performance has to be assessed continuously over the whole unit. The assessment will be made by comparing students' performance with the specified level of competencies. This helps you determine whether the student has achieved the minimum required level.

A student working at the minimum requirement level will be able to:

- define mechanized farming
- classify farm tools and equipment
- explain the uses of some farm tools and equipment

Students working above the minimum requirement level should be praised and their achievement recognized. They should be encouraged to continue working hard and not become self-satisfied.

Students working below the minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time during the breaks or at the end of the day.

Unit 15 Introduction to Human Nutrition

Periods allotted: 5 periods

Unit Introduction

This unit aims to introduce the students to the fundamentals of human nutrition. The unit addresses agriculture-nutrition linkage and nutrition sensitive agriculture. There are six classes of essential nutrients and their functions in the unit. In addition, six main food groups and their sources, as well as the concept of food and nutrition security are discussed in the unit. The status of malnutrition and its causes in Ethiopia is also stated briefly in the unit.

Learning Outcomes

At the end of this unit, your students will be able to:

- define basic terms used in human nutrition
- explain nutrients and their functions
- state food groups and their sources
- discuss food and nutrition security
- describe agriculture-nutrition linkage and nutrition-sensitive agriculture
- explain the status of malnutrition and its causes in Ethiopia

(15.1, 15.2). Definition of Basic Terms in Human Nutrition, and Nutrients and Their Functions

Periods allotted: 2 periods

Learning Competencies

At the end of this section, students will be able to:

- define basic terms used in human nutrition
- explain nutrients and their functions

Contents

- Definition of basic terms used in human nutrition
- Nutrients and their functions

Overview

In this section, the students will learn about human nutrition. Some basic terms in human nutrition are also defined in the unit. Nutrients are compounds in foods essential to life and health. There are six main classes of nutrients that the human body needs. These are carbohydrates, proteins, lipids (fats), vitamins, minerals and water. These nutrients and their functions as well as their sources are explained in this section.

Teaching-Learning Process

Suggested Instructional Materials

Food sources of carbohydrates, proteins, lipids (oils and fats), vitamins and minerals.

Suggested Teaching Methods

Brainstorming - Questioning – Gapped lecture - Group discussion and presentation

Pre-Lesson Preparation

In addition to the student's textbook, you can read materials that are relevant to the topic you are teaching. Some useful links are:

1. Essential Nutrients to Maximize Your Health: https://www.everydayhealth.com/hs/guide-to-essential-nutrients/simple-guide-to-good-nutrition/
2. Types and Functions of Nutrients: https://byjus.com/biology/nutrients/
3. Six essential nutrients: Sources and why you need them: https://www.medicalnewstoday.com/articles/326132

Presentation of the Lesson

a) Introduction to the lesson

Before you start teaching the topic, check the extent to which the students are familiar with 'human nutrition'. Then brainstorm them using the questions below:

- What is 'nutrition'?
- List the essential nutrients for our body.
- What are sources of foods for each nutrient type?

b) Body of the lesson

- Define basic terms in human nutrition such as nutrition, nutrients, healthy diet, micronutrients, macronutrients, etc.
- Explain the six classes of nutrients and their functions and sources
- Describe the energy share of carbohydrates, fats and proteins.

c) Stabilization

- The six classes of nutrients are carbohydrates, fats, minerals, proteins, vitamins, and water. All are nutrients that are essential to help the body function properly.

- Carbohydrates, fats, and proteins are macronutrients. Vitamins and minerals are micronutrients. Water is probably the most important essential nutrient that a person needs.
- For a healthy life, the energy share of carbohydrates, fats and proteins is recommended to be 55%, 30% and 15%, respectively.

Assessment and Follow-Up

a) Assessment

Check students understanding of the lesson by giving them an exercise to be done either in groups or individually. The exercise may comprise questions such as:

1. Define healthy diet
2. List the six classes of nutrients.
3. What are the recommended energy shares of carbohydrates, fats and proteins?
4. Write at least three sources of proteins.

b) Follow up

- You can ask the students to take notes about the six classes of nutrients and, their functions and sources.
- Students in groups should carry out activity 15.1.

c) Additional Questions

1. Write the two categories of nutrients.
2. Describe the two groups of minerals.

Answer to Activities and Additional Question

Answers to the additional questions

1. Nutrients can be of two types, depending on the amount required by our body. Some nutrients are required in large quantity and are called macronutrients. Examples are carbohydrates, fats, and proteins. Other nutrients required in a small quantity are called micronutrients.

Vitamins and minerals are micronutrients. Vitamins and minerals are micronutrients.

2. The two groups of minerals are major and trace minerals. Major or macro-minerals are elements with recommended dietary allowance (RDA) greater than 150 mg/day. Examples are magnesium, calcium, phosphorus, sulfur, sodium, potassium and chloride. Trace minerals are required in smaller amounts (microgram quantities). Examples are iron, selenium, zinc, and manganese.

15.3. Food Groups and Their Sources

Learning Competencies

Period allotted: 1 period

At the end of this section, the students will be able to:

- categorize food groups and their sources

Contents

- Food groups and their sources

Overview

Food group is a collection of foods that shares similar nutritional properties or biological classifications. Food is typically divided into groups based on their sources. The main food groups in a balanced diet include vegetable, fruit, fats/oils/sweets, legumes/nut, animal source, and staple food group. In this section, students will learn about the six food groups and their sources.

Teaching-Learning Process

Suggested Instructional Materials

Examples of foods from each of the six food groups (photographs/pictures)

Suggested Teaching Methods

Brainstorming - Questioning – Gapped lecture - Group discussion – Student presentation

Pre-Lesson Preparation

You can read other relevant materials for more ideas on the topic you are teaching. Some useful links are:

1. Food Groups and Nutrition Facts: https://cdn1.sph.harvard.edu/wp-content/uploads/sites/84/2012/09/ewkm_training_2_session_4_points.pdf
2. Food groups: how to eat a balanced diet: https://oneyouleeds.co.uk/blog/the-five-food-groups/

Presentation of the Lesson

a) Introduction to the lesson

Before you start teaching the topic, see the extent to which your students are familiar with the topic 'human nutrition'. Then, conduct a brainstorming session with the students using questions like the following:

- What does the term 'food group' mean?
- List three food types you enjoy eating.

b) Body of the lesson

- Explain the six food groups and their sources
- Tell the students the nutrients gained from each food group.

c) Stabilization

- The six food groups are vegetable, fruit, fats/oils and sweets, legumes and nut, animal source, and staple food groups. All are essential for the proper functioning of our bodies.

Assesment and Follow-Up

a) Assesment

Check students understanding of the lesson by giving them activities to be done either in group or individually. The exercise may include questions such as:

1. List the six food groups with examples for each group.

2. Write the nutrients supplied by the fruit food group.

b) Follow up

Students should carry out activity 15.2.

In addition, give students activities they do after the lesson. Ask them to list foods that are common in their localities. Ask them also to categorize the food types according to the six food groups.

c) Additional Questions

1. Ask them to summarize, using a table, the six categories of food along with their typical sources and the main nutrients they provide.

Answers for activities and additional question

Activity 15.1.

1. Students should list the food types available in their area and categorize them into the six food groups using some criteria. They may summarize in the table as shown below.

Name of the available foods	
(Students should list the name of each food item)	
Food group	
Vegetable	
Fruit	
Fats, oils and sweets	
Legumes and nut	
Animal source	
Staple	

Answers to the additional questions

1. Table 15.1: Summary of the six food groups, their sources and nutrients they provide

Food group	Sources	Nutrients provided
Vegetable	Cabbage, kale, spinach, cauliflower, lettuce, carrot, etc.	Vitamins, minerals, water and fiber
Fruit	Bananas, apples, avocados, grapes, pineapple, papaya, mango, etc.	Carbohydrates, vitamins, and water
Fats, oils and sweets	Cooking oil, butter, yogurt, meat, fish, poultry, etc.	Fat, protein
Legumes and nut	Groundnuts, soybeans, chick peas, broad beans, kidney beans, lentils, etc.	Fat, protein and carbohydrates
Animal source	Meat, poultry, eggs, milk/ milk products, fish, etc.	Protein, fats, vitamins, and minerals
Staple	Pasta, macaroni, sorghum, millet, maize, barley, oats, wheat, teff, rice, sweet potato, cassava, false banana, banana, etc.	Carbohydrates proteins and minerals

(15.4, 15.5). Food and Nutrition Security, and Agriculture-Nutrition Linkage and Nutrition-Sensitive Agriculture

Periods allotted: 2 period

Learning Competencies

At the end of this section, the students will be able to:

- discuss food and nutrition security
- describe agriculture-nutrition linkage and nutrition-sensitive agriculture

Contents

- Food and nutrition security
- Pillars of food and nutrition security
- Drivers of food/nutrition insecurity
- Agriculture-nutrition linkage and nutrition-sensitive agriculture

Overview

In this section, the students will learn about food and nutrition security. Food security refers to a condition in which all people, at all times, have the physical, social, and economic access to sufficient, safe and nutritious food. Nutrition security is the condition in which all people have a sustainable access to the basic elements of good nutrition, or to nutrients. The pillars of food/nutrition security and the causes of food insecurity are also the focus of this section. The four pillars of food/nutrition security are availability, access, utilization and stability. Agriculture-nutrition linkage describes the set of relationships that shows the mutual dependence of nutrition, health and agriculture. This is also part of this section.

Teaching-Learning Process

Suggested Instructional Materials

Diagrams or graphs showing the dimensions of food and nutrition security and their determinants

Suggested Teaching Methods

Brainstorming - Questioning - Lecture - Group activity

Pre-Lesson Preparation

For more ideas, read materials that are relevant to the topic you are teaching. Prepare the suggested materials with the link provided below.

- https://www.google.com/search?sxsrf=AJOqlzUw-c5Ak-qae_yEYRLPfCYQIkULjw:1678251013824&q=Diagrams+or+-graphs+showing+the+dimensions+of+food+and+nutrition+security+and+their+determinants&tbm=isch&source=univ&fir=NiMYAAwVMxwQKM%252C1pdKmA-6zuS4qkM%252C_%253BS2HKublxftNHeM%252C1pdKmA-6zuS4qkM%252C_%253BBWOOe0JVilJCHM%252CLCTYk-b798OK7qM%252C_%253BIPiNpsUanyj2bM%252CdLTL-4cF6Ttgx9M%252C_%253BWK4Tw82PD8qIKM%252Cd4zfis7Wd1AQgM%252C_%253BQvBSvGsbARh7TM%252Cp-fAk-hSQidYdTM%252C_%253BfWvd6yr3kMQbsM%252Cb-God7HZnPWE7gM%252C_%253BnbZiEjmDP7z4mM%252CdLT-L4cF6Ttgx9M%252C_%253BjIT12QVxRRM4PM%252C-CInx-TjXjYlNLM%252C_%253B3-IN_U5tl_EKgM%252CQ-zi9iXlTq28tjM%252C_&usg=AI4_-kQa-g8j7AqjQSguOoD-wRmYFk9jhNA&sa=X&ved=2ahUKEwjFhJecxMv9AhX-L8qQKHUiRDhEQjJkEegQICBAC
- https://www.fao.org/publications/sofi/2022/en/

Presentation of the Lesson

a) Introduction to the lesson

Before you start teaching the topic, check the extent to which your students are familiar with the topic food and nutrition security. Then, brainstorm the students by asking them questions like the following: What do you know about ‘food and nutrition security’?

b) Body of the lesson

Before you start teaching the topic, check the extent to which your students are familiar with the topic food and nutrition security. Then, brainstorm the students by asking them questions like the following: What do you know about ‘food and nutrition security’?

c). Stabilization

Summarize the following points

- Food and nutrition security
- Pillars of food/nutrition security
- Drivers of food/nutrition insecurity
- Agriculture-nutrition linkage
- Nutrition-sensitive agriculture

Assesment and Follow-Up

a) Assesment

Check the students' understanding of the lesson by giving them some exercise to be done either in groups or individually. The exercise may comprise questions such as:

1. What is the difference between food and nutrition security?
2. Explain the four pillars of food/nutrition security.
3. Describe nutrition-sensitive agriculture.

b) Follow up

Students should successfully complete activity 15.3.

c) Additional Question

1. Write the causes of food/nutrition insecurity.

Answers for Activities and Additional Questions

Activity 15.2.

Students in small groups should investigate the status of food and nutrition security in Ethiopia (or their specific area). They should explain what food insecurity exists and if any programmes in place to help with this.

Answers to the additional questions

1. People experience food insecurity usually due to lack of the following.

   a) resources (i.e., financial and other resource types)

b) access to nutritious food at affordable prices

c) access to food due to geographical isolation

d) motivation or knowledge about a nutritious diet

e) access to clean drinking water

f) environmental hygiene

g) good health infrastructure

15.6. Malnutrition and Its Cause in Ethiopia

Period allotted: 1 period

Learning Competencies

At the end of this section, the students will be able to:

- explain the status of malnutrition and its causes in Ethiopia
- propose mechanisms to tackle malnutrition

Contents

- Malnutrition and its forms
- Body Mass Index
- The magnitude of malnutrition in Ethiopia
- Causes, impacts and management of malnutrition

Overview

In this section, the students will learn about malnutrition status in Ethiopia. Malnutrition is a state in which the physical function of an individual is impaired. There are four types of malnutrition. These are stunting, wasting, being underweight, and deficiencies. Each type of malnutrition stems from a unique cause. The causes, effects, impacts and management of malnutrition are also the focus of this section.

Teaching-Learning Process

Suggested Instructional Materials

Graphs or diagrams that show the trend of malnutrition status in Ethiopia/ Africa/World.

Suggested Teaching Methods

Brainstorming - Questioning – Gapped lecture – Video show

Pre-Lesson Preparation

Plan your instruction and try to acquire updated information on the topic. Refer to materials that can help you develop better insight into the malnutrition status in Ethiopia/Africa/World. Prepare the following links:

- https://www.google.com/search?sxsrf=AJOqlzUxtXB-vMgAKTZsOtbFFyQS3mjpuUw:1678251159385&q=-Graphs+or+diagrams+that+show+the+trend+of+mal-nutrition+status+in+Ethiopia/Africa/World&tbm=isch&source=univ&fir=odaDRec_tsJybM%252CtAE-osCssn8EpXM%252C_%253BwLT64GjLmu_JcM%252CGbSTNXx3R3GwhM%252C_%-253B2YHFaR9dsJeyIM%252C-zxeikC8ZY6BhM%252C_%253B-ZLLtge0yRaEgoM%252CTh5ftBtZrXemhM%252C_%253B-khaBAHQngnjkSM%252CB2-z8YGc78DbwM%252C_%253BJ6H-KrEUdU1H6QM%252Ck9iAbTpr4PzIIM%252C_%253BNze-Qa-fvdkNZ2M%252CHIsk7hMu5PfOvM%252C_%253BL4GkDt8L-r3b68M%252CtAEosCssn8EpXM%252C_%253Bvnxg_gi3Se-Ke1M%252CrVS-4s5b7s0yIM%252C_%253BwKaW6MmN31R-BlM%252C4bu9Xer0vtsJyM%252C_&usg=AI4_-kReHAN-tKY-OikVQTnR6Id_oHKK-vQ&sa=X&ved=2ahUKEwisu8vhxMv9A-hUIG-wKHaSdA-0QjJkEegQICBAC
- https://globalnutritionreport.org/resources/nutrition-profiles/africa/eastern-africa/ethiopia/

Presentation of the Lesson

a) Introduction to the lesson

Brainstorm the students by asking questions like the following:

- Do you have any idea about the concept of malnutrition?

- Tell us the causes, effects and management of malnutrition.

b) Body of the lesson

- Introduce the students to the concept of malnutrition and its consequences
- Discuss the four types or forms of malnutrition. (These are stunting, wasting, underweight, and deficiencies)
- Describe briefly Body Mass Index
- Help students to understand the status of stunting, wasting and underweight in Ethiopia (Table 15.2 in student textbook). Where possible, display the graphs or diagrams that show the trend of malnutrition status in Ethiopia/Africa/World.
- Describe the causes, impacts and management of malnutrition

c). Stabilization

Summarize the following points.

- Malnutrition and its consequences
- Types/forms of malnutrition
- Body Mass Index
- Causes, impacts and management of malnutrition

Assessment and Follow-Up

a) Assesment

Check the students' understanding of the lesson by asking them questions. Note that your questions are based on the stated specific objectives of the lesson.

Students should complete activity 15.4 and 15.5 (Class work the data response questions and effects of malnutrition)

b) Follow up

To help your students read more on the topic, give them tasks on the lesson. For example, you can ask them to read and report on tasks such as the

following ones.

- The current status of overweight, stunting, wasting and underweight in Ethiopia
- The different types of deficiencies

c) Additional Questions

1. Write the impacts of malnutrition.
2. How can malnutrition be managed?

Answers to Activities and Additional Questions

Activity 15.4.

Students should answer the data response questions after looking carefully at the data in the Table 15.2. Students are expected to review national evidence and explain why stunting and underweight decline in 2019 compared to 2000. They should also visit the nearby health office, to consult them and identify major changes that resulted in a decrease in the status of malnutrition over the past few years?

Activity 15.5.

Short term impacts of malnutrition	Long term impacts of malnutrition
▪ Weakness ▪ altered immunity ▪ much more vulnerable to infections ▪ death ▪ child mortality	▪ impaired mental development, educational performance in childhood and work productively in adulthood ▪ fail to recover from diseases and can't perform their daily work ▪ poor economic status for individuals, societies and the country at large

Additional Questions

1. Malnutrition generally decreases productivity and increases deaths, illness, disability, poor reproductive and poor educational performance. These all lead to poor economy. Malnutrition results in the loss of body tissues, causes muscular dysfunction, weakness, altered immunity and predisposes individuals to different infections.
2. Malnutrition can be managed in the following ways.

   a) Dietary changes, such as eating foods high in energy and nutrients

   b) Support for families to help them manage factors affecting the child's nutritional intake

   c) Treatment for any underlying medical conditions causing malnutrition.

Answer Key to Review Exercise

Part I

1. A
2. C
3. D
4. B
5. C
6. C
7. D

Part II

1. The different types of nutrients required by human body are carbohydrates, fats, proteins, minerals, vitamins, and water. These are essential to for the body to function properly.
2. The difference between food and nutrition security is that: food security is the availability and the access of food to all people; whereas nutrition security demands the intake of a wide range of foods which provides the essential needed nutrients.
3. The basic components or pillars of food and nutrition security are availability, access, utilization and stability.
4. The four types of malnutrition are stunting, wasting, being underweight, and deficiencies. Malnutrition leads to inadequate bodily resistance to recover from diseases or it leads to failure to perform physical work. Promoting food diversification, nutrient enrichment, nutrition

sensitive agriculture, etc. can be suggested as solutions to overcome the associated problems

Check List

Check the student's performances according to the given competencies. Use the questions in the check list for every unit. Put a tick (√) mark against each task to see whether they are able to perform in the competencies of each unit. The students are expected to respond saying 'Yes' or 'Partly' or 'No'. Following that, you can make your own evaluation and whether the competencies are met or not.

Check the student's performance against the learning outcomes.

Can you:

		Yes	Partly	No
1	define basic terms in human nutrition?.....			
2	explain nutrients and their functions?			
3	state food groups and their sources?			
4	discuss food and nutrition security?			
5	describe agriculture-nutrition linkage and nutrition sensitive agriculture?			
6	explain the status of malnutrition and its causes in Ethiopia?.....			

Unit Assessment

Students' performance has to be assessed continuously over the whole unit. The assessment will be made by comparing students' performance with the specified level of competencies. This will help you determine whether the student has achieved the minimum required level.

A student working at the minimum requirement level will be able to:

- define basic terms used in human nutrition
- explain nutrients and their functions
- state food groups and their sources
- discuss food and nutrition security
- describe agriculture-nutrition linkage and nutrition-sensitive agriculture
- explain the status of malnutrition and its causes in Ethiopia.

Students working above the minimum requirement level should be praised and their achievement recognized. They should be encouraged to continue working hard and not become self-satisfied.

Students working below the minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional lesson time during the breaks or at the end of the day.

Unit 16 Diversified Food Production and Consumption

Periods allotted: 4 periods

Unit Introduction

In this unit, the students will learn about the role of diversified food production and consumption, dietary diversification and nutrient enrichment/modification strategies. The role of indigenous knowledge in nutrition sensitive agriculture is also addressed in the unit.

Learning Outcomes

At the end of this unit, your students will be able to:

- explain the significance of diversified food production
- describe the dietary diversification strategies
- describe the nutrient enrichment/ modification strategies
- appreciate the roles of indigenous knowledge in nutrition-sensitive agriculture

16.1. Importance of Diversified Food Production

Period allotted: 1 period

Learning Competencies

At the end of this section, the students will be able to:

- explain role of food diversification and consumption

Contents

- Importance of diversified food production

Overview

Agricultural food diversification is the act of introducing or producing a variety of food from agricultural activities like crop or animal farming. It is important to produce and consume different types of food. Different food types provide different nutrients that people need to be healthy. In this section, the students will learn about the importance of diversified food production.

Teaching-Learning Process

Suggested Instructional Materials

Flip chart, marker pen, stickers, etc.

Suggested Teaching Methods

Brainstorming - Questioning – Gapped lecture – Video show

Pre-Lesson Preparation

Adequate level of preparation is important. This involves reading materials related to the topic for more ideas. Links are provided below and the likes.

- Best Integrated Farm in the World: https://youtu.be/WT6WJZK8VWY?t=5
- Integrated farming system: https://youtu.be/tJhpRxhMvvA?t=21

Presentation of the Lesson

a) Introduction to the lesson

Before presenting your lesson to the class, check the students' level of

prior knowledge in the area by asking some questions. This would help you to identify the existing gaps in the students learning. You can start your lesson by raising such questions as:

- What is food diversification?
- Do you always eat the same type of food?
- List down the types of food you enjoy eating.
- What are the sources of the food you enjoy eating?
- List two roles of food diversification and consumption.

Post a flip chart on the wall of the classroom. Ask the students to write one answer to each of the above questions on the posted flip chart. They will help you understand the progress of the students' learning.

b) Body of the lesson

Discuss the role of agriculture as an indispensable sector for food and nutrition security

Describe the importance of diversified food production

Explain integrated farming system (Figure 15.1). You can use videos prepared.

c) Stabilization

Give a summary of the roles of food diversification and consumption and the integrated farming system. Summarise the main points of the videos displayed.

Assessment and Follow-Up

a) Assessment

At the end of the lesson, make sure that your students have understood the essential concepts of the section by asking those questions and giving them tasks like the following.

1. What is the importance of diversified food production? What is its aim?
2. Ask students to give a presentation on the main points of the videos

they see (Peer assessment)

b) Follow up

To help your students get more ideas on the topic, you can have them work on topics that are related to your lesson. For example, ask them to make notes in their books on the importance of diversified food production.

c). Additional question

1. Why is it important to have a variety of foods?
2. Explain integrated farming system.

Answer to Activities and Additional Questions

Answer key to the additional question

1. Different foods provide different nutrients that people need to be healthy:
   - Children need a variety of foods to grow well and to develop properly.
   - Adults need a variety of foods to have energy and be productive.
   - Women who are pregnant or breastfeeding need different foods for the baby and for themselves to be healthy and strong.
2. Integrated farming system is a system of farm practice which concurrently utilizes the same unit area of land for the production of animals and crops. The system produces a range of foods including local crops and vegetables, livestock (chicken and pigs) and fish. These foods are important for a healthy, balanced diet and income generation.

(16.2, 16.3, 16.4) Dietary Diversification; Nutrient Enrichment Strategies, and Indigenous Knowledge in Nutrition-sensitive Agriculture

Periods allotted: 3 period

Learning Competencies

At the end of this lesson, the students will be able to:

- describe dietary diversification strategies
- discuss the nutrient enrichment/ modification strategies
- explain indigenous knowledge and its application in nutrition sensitive agriculture

Contents

- Dietary diversification strategies
- Nutrient enrichment/ modification strategies
- Indigenous knowledge in nutrition sensitive agriculture

Overview

This section is on the role of indigenous knowledge in nutrition sensitive agriculture. In the section, the students will describe dietary diversification and nutrient enrichment strategies as well as the role of indigenous knowledge in nutrition sensitive agriculture.

Dietary diversity is defined as the number of individual food items or food groups consumed over a given period of time. Since the different food groups provide different benefits, consumption of diversified foods is important for the health of adults and proper growth and development of children. Strategies for food and dietary diversification at the community and household levels include a range of food-based activities that can maximize the availability of adequate amounts and a greater variety of nutritious foods.

There are several types of nutrient enrichment/modification strategies. These include fortification, germination, fermentation and roasting. Nutrition sensitive agriculture is an approach to agricultural development

that prioritizes nutritionally rich foods farming, dietary diversity, and food fortification. Nutrition sensitive agriculture aims to tackle malnutrition and micronutrient deficiencies.

Teaching-Learning Process

Suggested Instructional Materials

Petri-dish, water sprayer, grains/pulses (such as bean), filter paper, etc., video

Suggested Teaching Methods

Brainstorming - Questioning – Gapped lecture - Buzz-group discussion – Student presentation - Demonstration - Video show

Pre-Lesson Preparation

Good to read on the topic. Read relevant books, search the internet or consult various published and unpublished documents on the area. Encourage the students to read the topic on dietary diversification and nutrient enrichment strategies in their textbook and other relevant materials. Guide the students to develop the habit of reading suggested reference materials.

Prepare videos on Nutrition-sensitive Agriculture. Some useful links are:

1. https://www.fao.org/global-soil-partnership/areas-of-work/soil-fertility/nutrition-sensitive-agriculture/ru/
2. https://elearning.fao.org/course/view.php?id=663

Presentation of the Lesson

a) Introduction to the lesson

You can start this topic by organizing buzz-group to discuss dietary diversification strategies. Give group leaders opportunities to present the summary of their discussions.

You can also them brainstorming questions as (Brainstorming 16.2):

- Guess what nutrient enrichment is.

- What does nutrient enrichment involve, in your opinion?
- Why is enriching nutrients important?
- What is nutrition-sensitive agriculture?

b) Body of the lesson

- Explain the dietary diversification strategies
- Describe dietary modifications and the reasons for diet modification
- Discuss the aim of nutrient enrichment/modification
- Describe the different strategies of nutrient enrichment/modification. The strategies are fortification, germination, fermentation and roasting in terms of their meaning, procedure and advantages.
- Demonstrate how germination of grains/pulses works
- Describe the concept of nutrition-sensitive agriculture and its aim/ objective
- Explain the role of indigenous knowledge in nutrition-sensitive agriculture

c) Stabilization

Give a summary of the following topics.

- Dietary diversification strategies
- Reasons for diet modification
- Nutrient enrichment/modification strategies
- The role of indigenous knowledge in nutrition sensitive agriculture

Assessment and Follow-Up

a) Assessment

At the end of the lesson, make sure that your students have understood the essential concepts of the lesson by asking them questions and giving them tasks like the following.

1. What is diet diversity?
2. List food-based activities that are used for dietary diversification.
3. Ask students to write a list of the advantages and disadvantages of fermentation technique of nutrient enrichment.
4. Ask students to prepare a poster showing the most common fortified foods?

b) Follow up

To help your students get more ideas on the topic, you can have them work on topics that are related to the lesson. For example, ask them to make notes from relevant materials/books on the dietary diversification strategies.

Students should investigate the rate of germination in bean or lentil (Activity 16.2). This involves making a simple investigation to run-through germination of bean. Several students can work together. This investigation may take several days. At the end of the activity, let them report the results of their investigation.

Students should carry out activity 16.3 individually. Encourage them to share their work with their neighbors.

To help your students get more on the topic of indigenous knowledge in nutrition sensitive agriculture, you can have them work on topics that are directly related to your lesson. For example, give them assignments to be done at home on the following topics. They may make a poster, write a report, collect data, etc.

- Area specific traditional foods – what are they?
- Wild plants that are consumed by local communities – name them.

c) Additional Questions

1. What is food fortification?
2. Why is food fortification important?
3. Why is it important to promote nutrition sensitive agriculture in Ethiopia?
4. List two traditional foods in Ethiopia.

Answer to Activities and Additional Questions

Activity 16.2.

You can design this experiment with a range of grains/pulses which are common in the local area. Place a filter paper over the Petridish. Scatter the bean or lentil over the paper. Then moisten or soak it with ample amount of water. Do these daily until it becomes sprouted. This investigation may take several days. Report the results of your investigation. Encourage students prepare a note on benefit of germination and to present to their families and report back to the class.

Activity 16.3.

Students should answer each of the questions individually first, and then, share their thoughts with their neighbors.

Students should keep a diary to list all of the different foods that they eat within a week. Count the number of different foods. Do they think that your diet is sufficiently diverse?

Students should visit a market in their premises and find out if there are any new foods which they have not tried. Ask them to make a list of new foods they have seen which they could add to their diet to make it more diverse. Always encourage students to share their findings and compare with others.

Answers to the additional questions

1. Food fortification is the process of deliberately increasing the content of essential micronutrients in food.
2. Fortification is important to:
    - improve the nutritional quality of food supply

- reduce the number of people with dietary deficiencies

3. Ethiopia is a country where malnutrition is widespread and affecting the health and development of the nation. Malnutrition has short and long-term impacts and needs to be addressed with a sense of urgency. Nutrition sensitive agriculture can tackle all forms of malnutrition. This approach stresses the multiple benefits derived from enjoying a variety of foods, recognizing the nutritional value of food for good nutrition, and the importance and social significance of food and agricultural sector for supporting livelihoods.
4. *Chuko* and *Kocho*

4. Answer Key to Review Exercise

Part I

1. C
2. B
3. D
4. A
5. C

Part II:

1. The advantages of germination technique of nutrient enrichment include the following.
   - Germination helps to increase the digestibility of foods and the nutritive value of food with no additional cost.
   - Some carbohydrates and proteins are broken down into smaller and easily digestible forms.
   - Grains and pulses become soft after sprouting, so they take less time for cooking and become easy to digest.
   - Some vitamins and minerals become more when foods are germinated. Vitamin B becomes almost double in quantity while vitamin C increases almost 10 times.
2. Nutrition sensitive agriculture is a food-based approach to agricultural development that prioritizes nutritionally rich foods, dietary diversity, and food fortification as a means to overcome malnutrition and micronutrient deficiencies.
3. Different foods provide different nutrients that people need to be

healthy:

- Children need a variety of foods to grow well and to develop properly.
- Adults need a variety of foods to have energy and be productive.
- Pregnant or breastfeeding women need different foods for the baby and for themselves to be healthy and strong.

Check List

Check the student's performance according to the given competencies. Refer to the questions in the check list for every unit. Put a tick (√) mark against each task to see whether they are able to perform in the competencies of each unit. The students are expected to respond saying 'Yes' or 'Partly' or 'No'. After that, you can make your own decision about whether the competencies are met or not.

Check the student's performance against the learning outcomes

Can you:

		Yes	Partly	No
1	explain the importance of food diversification and consumption? ….			
2	describe dietary diversification strategies?			
3	discuss nutrient enrichment/ modification strategies? ……			
4	appreciate the role of indigenous knowledge in nutrition sensitive agriculture?.....			

Unit Assessment

Students' performance has to be assessed continuously over the whole unit. The assessment will be made by comparing students' performance with the specified level of competencies. Assessment helps to determine whether the student has achieved the minimum required level.

A student working at the minimum requirement level will be able to:

- explain the significance of diversified food production
- describe the dietary diversification strategies
- describe the nutrient enrichment/ modification strategies
- appreciate the roles of indigenous knowledge in nutrition-sensitive agriculture.

Students working above the minimum requirement level should be praised and their achievement recognized. They should be encouraged to continue working hard and not become self-satisfied.

Students working below the minimum requirement level will require extra help if they are to catch up the rest of the class. They should be given extra attention in class and additional lesson time during the breaks or at the end of the day.

MINIMUM LEARNING COMPETENCY OF AGRICULTURE FOR GRADE 11

Unit	*Competencies*
	Grade 11
1. Introduction to Crop Production	▪ Define common terms ▪ Explain origin of different domesticated crops ▪ Describe the status of crop production ▪ Classify crop plants ▪ Mention and explain different cropping systems ▪ Define indigenous knowledge and explain its importance in crop production ▪ Mention types of indigenous knowledge's applicable in crop
2. Field Crops Production and Management	▪ Define field crops, cereal and pulse crops ▪ Identify the major cereals and pulses produced in Ethiopia, their uses ▪ Elaborate the status of cereal and pulse crops production ▪ Explain the growth requirements of the major cereals and pulses produced in Ethiopia ▪ Show positive attitude for the production of field crops

Unit	Competencies Grade 11
3. Industrial Crops Production and Management	▪ Define industrial crops, oil, fiber and sugar crops ▪ Mention the major industrial crops produced in Ethiopia ▪ Identify the major uses and growth requirements of oil, fiber and sugar crops ▪ Elaborate the status of industrial crops production and prospects ▪ Create motivation for the production and management of industrial crops
4. Introduction to Farm Animals	▪ Describe common terms used in farm animal production ▪ Explain the origin and domestication of farm animals ▪ Analyze the importance of farm animals ▪ Describe the constraints in animal production and their mitigation strategies ▪ Explain the different animal production systems

Unit	Competencies Grade 11
5. Animal Feeds and Feeding Practices	▪ Identify types of animal feeds and available resources in their localities ▪ Categorize the different feed resources in to roughages and concentrates ▪ Explain the nutrient requirements of farm animals ▪ Explain functions and sources of basic nutrients ▪ Analyze factors considered in feed formulation ▪ Prepare a ration through the person's square method of formulation ▪ Demonstrate feeds conservation as hay and silage ▪ State the main stages of compound feed manufacturing
6. Basic Animal Health and Disease Control	▪ Recognize major diseases of farm animals ▪ Describe the importance of diseases and parasites in animal production ▪ Explain the prevention and control of common livestock diseases ▪ Mention types of indigenous knowledge on animal health management practices in your area

Unit	Competencies Grade 11
7. Animal Genetics and Breeding Practices	▪ Define concepts of animal genetic and breeding ▪ Explain genetic or breed improvement methods ▪ Describe farm animal reproductive technologies ▪ Analyze the importance of identification and record keeping
8. Farm Animal Housing	▪ Discuss the significance of farm animal house ▪ Describe the types of animal housing ▪ State farm animal welfare issues ▪ Exercise site selection for animal shelter and house construction
9. Dairy Cattle Production and Management	▪ Identify different dairy cattle breeds and selection methods ▪ Explain dairy cattle feeding management ▪ Describe milk production and processing ▪ Explain dairy cattle housing ▪ Identify the major disease/parasites of dairy cattle and control methods ▪ Mention types of indigenous knowledge on dairy cow health management practices in your area ▪ Calculate profitability in dairy business

Unit	*Competencies*
	Grade 11
10. Introduction to Natural Resources	▪ Define natural resources as used in the unit ▪ Describe natural resources in their areas ▪ Classify natural resources into renewable and non-renewable resources ▪ Explain the importance of natural resources ▪ Describe the causes of natural resource degradations ▪ Explain the consequences of natural resource degradation ▪ Suggest methods of fixing natural resource degradations
11. Management of Natural Resources	▪ Explain soil management ▪ Explain agricultural water management ▪ Clarify forest and wildlife management ▪ Explain environmental management ▪ Explain climate change and adaptation practices ▪ Mention types of indigenous knowledge's applicable in natural resources management practices

Unit	Competencies Grade 11
12. Concepts of Biodiversity	▪ Define what biodiversity mean and its scopes ▪ Explain values and services of biodiversity ▪ Explain threats to biodiversity ▪ Clarify forest and wildlife management ▪ Explain environmental management ▪ Describe biodiversity conservation and the status of status of conservation in Ethiopia
13. Climate Change Adaptation and Mitigation	▪ Define climate change and climate variability. ▪ Explain climate change and its effects ▪ Clarify climate change mitigation strategies ▪ Describe climate change adaptation strategies of Ethiopia ▪ Mention types of indigenous knowledge in climate change mitigation strategies
14. Mechanized Farming	▪ Explain what does mechanize farming means ▪ Mention types of farm tools and equipment ▪ Elaborate the use of common farm tools and equipment

Unit	Competencies Grade 11
15. Introduction to Human Nutrition	▪ Define basic terms in human nutrition ▪ Elaborate agriculture-nutrition linkage and nutrition sensitive agriculture ▪ Clarify nutrients and their functions ▪ Identify food groups and their sources ▪ Discuss food and nutritional security ▪ Explain malnutrition status in Ethiopia
16. Diversified Food Production and Consumption	▪ Explain the role of food diversification and consumption ▪ Describe dietary diversification strategies ▪ Describe nutrient enrichment/ modification strategies ▪ Appreciate indigenous knowledge applied on food diversification

Federal Democratic Republic of Ethiopia

Ministry of Education

AGRICULTURE SYLLABUS

For Grade 11

Theme: Crop Production and Management

Unit One: Introduction to Crop Production *(8 periods)*

Learning Outcomes: At the end of this unit, students will be able to:

- define crop production related terms/phrases
- explain origin of different domesticated crops
- elaborate the status of crop production
- classify crop plants
- know different cropping systems and principles of crop husbandry
- define and explain indigenous knowledge used related to crop production

Competencies	*Main Contents*	*Suggested Activities*
Students will be able to: ▪ define common terms ▪ explain the origin of domesticated crops ▪ describe the status of crop production ▪ classify crop plants ▪ know different cropping systems ▪ define indigenous knowledge ▪ explain the importance of indigenous knowledge in crop production ▪ mention types of indigenous knowledge's applicable in crop production	**1. Introduction to Crop Production** 1.1. Definition of terms 1.2. The origin of domesticated crops 1.3. Classification of crop plants and status of crop production in Ethiopia 1.4. Cropping systems 1.5. Indigenous knowledge in crop production	▪ Students are asked to define common terms used in crop production, and to explain the origin of domesticated crops. ▪ Arrange small group exercises so that students classify domesticated crops. Finally, consolidate the points by whole class discussion. ▪ Let students to explain the status of crop production and principles of crop husbandry and, to mention different types of cropping systems. ▪ Let students define indigenous knowledge (IK) and explain the importance of IK in crop production. Then, ask them to mention types of IK's applicable in crop production.

Theme: Crop Production and Management

Unit Two: Field Crops Production and Management *(7 periods)*

Learning Outcomes: At the end of this unit, students will be able to:

- define field crops, cereal and pulse crops
- identify the major cereals and pulses produced in Ethiopia, their uses
- elaborate the status of cereal and pulse crops production
- explain the growth requirements of the major cereals and pulses produced in Ethiopia
- show positive attitude for the production of field crops

Competencies	*Main Contents*	*Suggested Activities*
Students will be able to: ▪ define field crops, cereal and pulse crops ▪ identify the major cereals and pulses produced in Ethiopia, their uses ▪ elaborate the status of cereal and pulse crops production ▪ explain the growth requirements of the major cereals and pulses produced in Ethiopia ▪ show positive attitude for the production of field crops	**2. Field Crops Production and Management** Cereal crops production and management 2.2. Pulse crops production and management	▪ After providing introductory information on the terms and definition of field crops, students are asked to list the importance, problems and prospect of field crops production in Ethiopia. ▪ Arrange small group discussion so that students identify environmental factors that influence field crops production. After learners are immersed in the discussion direct them to classify field crops based on different parameters. ▪ Ask students to list the types of field crops production systems. Then, let the students to explain principles of field crops management.

Theme: Crop Production and Management

Unit Three: Industrial Crops Production and Management *(7 periods)*

Learning Outcomes: At the end of this unit, students will be able to:

- define industrial crops, oil, fiber and sugar crops
- mention the major industrial crops produced in Ethiopia
- identify the major uses and growth requirements of oil, fiber and sugar crops
- elaborate the status of industrial crops production and prospects
- create motivation for the production and management of industrial crops

Competencies	*Main Contents*	*Suggested Activities*
Students will be able to: ▪ define industrial crops, oil, fiber and sugar crops ▪ mention the major industrial crops produced in Ethiopia ▪ identify the major uses and growth requirements of oil, fiber and sugar crops ▪ elaborate the status of industrial crops production and prospects ▪ create motivation for the production and management of industrial crops	**3. Industrial Crops Production and Management** 3.1. Oil crops production and management 3.2. Fiber crops production and management 3.3. Sugar crops production and management	▪ After providing introductory information on the industrial crops production and management, students are asked to list the importance of industrial crops production in Ethiopia. ▪ Students are asked to classify industrial crops based on different parameters. ▪ Make small groups so that students practice production and management of oil crops, fiber crops and sugar crops.

Theme: Animal Production and Management

Unit Four: Introduction to Farm Animals *(5 periods)*

Learning Outcomes: At the end of this unit, students will be able to:

- describe common terms used in animal production
- explain the origin and domestication of farm animals
- compare the gastro intestinal tract of a ruminant and a monogastric animal
- internalize the importance and values of domestic animal production
- describe the constraints in animal production and mitigation strategies
- identify the features of the different animal production systems in Ethiopia

Competencies	*Main Contents*	*Suggested Activities*
Students will be able to: ▪ explain common terms used in animal production ▪ state the importance of domesticated animals ▪ mention the factors affecting animal production ▪ mention the different animal production systems	**4. Introduction to Farm Animals** 4.1. Farm animal species 4.2. Animal production and its importance 4.3. Constraints in animal production and mitigation strategies 4.4. Animal production systems	▪ Students are provided with introductory information on the basics of farm animals, and asked to explain the common terms used in animal production such as species, breed and domestication. ▪ Organize small groups so that students discuss on origin, domestication, and importance of farm animals. They also directed to discuss on the constraints and systems of animal production in Ethiopia. Let the group leaders present the outcomes of their discussions to the whole class. You should monitor and encourage the group discussions and presentations. Finally, record their group discussion results and provide them timely feedback.

Theme: Animal Production and Management

Unit Five: Animal Feeds and Feeding Practices *(6 periods)*

Learning Outcomes: At the end of this unit, students will be able to:

- identify types of animal feeds and available resources in their localities
- categorize the different feed resources in to roughages and concentrates
- explain the nutrient requirements of farm animals
- explain functions and sources of basic nutrients
- analyze factors considered in feed formulation
- prepare a ration through the Person's square method of formulation
- demonstrate feeds conservation as hay and silage
- state the main stages of compound feed manufacturing

Competencies	*Main Contents*	*Suggested Activities*
Students will be able to: ▪ identify the types of animal feeds and available resources ▪ mention the names of different feed resources ▪ explain feed and nutrient requirements of different animals ▪ analyze the factors considered in feed formulation ▪ conserve feeds properly	**5. Animal Feeds and Feeding Practices** 5.1. Feed resources in Ethiopia 5.2.Classification of feed resources 5.3. Feed and nutrient requirements of animals 5.4.Feed formulation principles and practices 5.5.Feed conservation and compound feed manufacturing	▪ Students are provided with introductory information on animal feeds and feeding practices, and asked to mention the feed resources of farm animals. ▪ Arrange students-in-pair group to identify feed and nutrient requirements of different species and categories of farm animals. In addition, organize buzz-group so that students discuss on feed formulation and compound feed manufacturing. Let leaders from each group present their discussion outcomes to the whole class. You should monitor and encourage their discussions and presentations for both activities. ▪ You should explain to students the purpose of feed conservation and describe the two common methods (i.e., hay and silage making). You should also pay attention to developing students' affective and psychomotor skills. To this end, direct students in small groups to field level activity. So that they are expected to conserve successfully a typical feed (hay and/or silage). Each group should write a field report and present to the rest of the class. You should check the field level activities, record the practices and participations of students. Finally, assess them based on the records provide them timely feedback.

Theme: Animal Production and Management

Unit Six: Animal Genetics and Breeding Practices *(5 periods)*

Learning Outcomes: At the end of this unit, students will be able to:

- define concepts of animal genetics and breeding practices
- explain breed improvement methods (introduction, selection and breeding)
- describe animal reproductive technologies (artificial insemination and embryo transfer)
- analyze the importance of animal identification and record keeping

Competencies	*Main Contents*	*Suggested Activities*
Students will be able to: ▪ define concepts of animal genetics and breeding ▪ explain breed improvement methods ▪ describe artificial insemination (AI) and reproductive technologies ▪ analyze the importance of identification and record keeping	**6. Animal Genetics and Breeding Practices** 6.1. introduction to animal genetics and breeding 6.2. Breed improvement methods 6.3. Animal reproductive technologies 6.4. Identification and record keeping (practical)	▪ You should offer students an introductory information on animal genetics and breeding, and ask them to describe the concepts of animal genetics and breeding practice. ▪ Organize pair-work groups so that students may identify the three breed/ genetic improvement methods. These are introduction, selection and breeding. You should also organize a buzz-group and ensure that students discuss on reproductive technologies including artificial insemination (AI), embryo transfer and cloning. For each activity, let each group share the most important points of their work to the whole class. ▪ Plan a farm visit in order to ensure that students practice or demonstrate animal identification and record keeping. They should complete report writing and let each group present to the class. You should correct the practical report and provide timely feedback.

Theme: Animal Production and Management

Unit Seven: Farm Animal Housing *(3 periods)*

Learning Outcomes: At the end of this unit, students will be able to:

- examine the significance of farm animal house
- analyze the different types of animal housing
- select sites for animal shelter and house construction
- construct model shelters and houses for animals

Competencies	*Main Contents*	*Suggested Activities*
Students will be able to: ▪ discuss the significance of farm animal house ▪ describe the types of animal housing ▪ exercise site selection for animal shelter or house construction	**7. Farm Animal Housing** 7.1. Significance of housing 7.2. Types of animal house 7.3. Guidelines for site selection and house construction	▪ At the outset of this unit, check the knowledge of students by question and answer. For example, you can ask students the importance of farm animal house. ▪ Organize pair-work so that students describe different types of animal housing. These are conventional barns, loose housing, free range and modern farms such as hen's aviary or cage system. Let each group explain to the class and provide them encouraging feedback. ▪ Arrange field activities to ensure that students in small groups are exercise or practice on site selection and related activities for animal shelter or house construction. At the end, let them to prepare a report for what they did and present the outcomes of field activities. You should correct the field report and provide them timely feedback.

Theme: Animal Production and Management

Unit Eight: Basic Animal Health and Disease Control *(6 periods)*

Learning Outcomes: At the end of this unit, students will be able to:

- recognize major diseases of farm animals (viral, bacterial, protozoan, and parasitic)
- describe the main groups of parasites (internal and external)
- describe the effect of diseases and parasites in animal production
- explain the prevention and control of common farm animal diseases
- appreciate the role of indigenous knowledge in animal disease management

Competencies	*Main Contents*	*Suggested Activities*
Students will be able to: ▪ recognize major diseases of farm animals ▪ describe the importance/ effect of diseases and parasites in animal production ▪ explain the prevention and control of common farm animals diseases ▪ explain indigenous knowledge in animal disease management	**8. Basic Animal Health and Disease Control** 8.1. Major diseases of farm animals 8.2. Importance of diseases and parasites in animal production 8.3. Prevention and control of common farm animals diseases 8.4. Indigenous knowledge in livestock disease treatment	▪ Students are provided with preliminary information on animal health and disease; including the definition of each term, routes of pathogen transmission and symptoms of sick animals. ▪ Students are asked to mention some diseases of farm animals they already know elsewhere. Then, you should explain sufficiently the two types of diseases (infectious and non-infectious) and the most common farm animal diseases in Ethiopia. Also, describe the internal and external parasites. ▪ You should describe the effect of disease/parasites in animal farming. Stress your description in terms of morbidity, mortality, economic loss and zoonoses. Organize pair-work so that students identify the importance/ effects of farm animal diseases and parasites in animal production. Let each group present the main points of the discussion to the whole class. You should monitor and encourage the group discussions and presentations. Finally, record their discussion results and provide constructive feedback.

Competencies	Main Contents	Suggested Activities
		▪ Students in small groups are assigned on particular livestock farms to check healthy and sick animals. Again, arrange a field visit so that students in small groups are allowed to explore the role of indigenous knowledge in livestock disease management. After each field visit, they should write a short report that explain briefly the main points of each farm visit. Let each group present to the whole class. You should monitor and guide them during their field visit activity/presentations; and record carefully the assessment of their field reports. Always value/appreciate their work and provide them timely feedback.

Theme: Animal Production and Management

Unit Nine: Dairy Cattle Production and Management *(8 periods)*

Learning Outcomes: At the end of this unit, students will be able to:

- recognize different dairy cattle breeds and selection methods
- describe dairy cattle feeding management
- explain milk production and processing
- explain dairy cattle housing, sanitation and manure management
- mention the major diseases of dairy cattle and control methods in their localities
- calculate profitability in dairy business

Competencies	*Main Contents*	*Suggested Activities*
Students will be able to: ▪ identify the different dairy cattle breeds and selection methods ▪ explain the feed resources and feeding methods of dairy cattle ▪ describe milk production and processing ▪ explain dairy cattle housing ▪ list the major diseases/ parasites of dairy cattle and control methods ▪ calculate profitability in dairy business	**9. Dairy Cattle Production and Management** 9.1. Introduction to dairy cattle production and management 9.2. Dairy cattle breeds and selection 9.3. Dairy cattle feeds resources and feeding 9.4. Milk production and processing 9.5. Dairy cattle housing management 9.6. Major disease of dairy cattle and control methods 9.7. Profitability in dairy business	▪ Provide the class introductory information on dairy cattle, and ask them to mention dairy cattle breeds and selection methods. ▪ Organize pair-work so that students identify dairy cattle feeds and feeding methods. Students in group should also directed to discuss on milk production and demonstrate milk processing aspects. At the end of each activity, let the group leaders present the outcomes of their discussions to the whole class. You should monitor and encourage group discussions and presentations. Finally, record their group discussion results and provide them timely feedback. ▪ Arrange students in small groups to visit a dairy cattle housing. Order them to write a report explain briefly aspects such as the type of housing found in that area, its features, advantages, etc. You are always advised to correct their report and provide them feedback. ▪ You should discuss the topic of dairy cattle disease and their control measures. As stabilization, provide students class work to list the major disease of dairy cattle and control methods.

Theme: **Natural Resources Management**

Unit Ten: Introduction to Natural Resources *(6 periods)*

Learning Outcomes: At the end of this unit, students will able to:

- define natural resources as used in the unit
- describe natural resources in their areas
- classify natural resources into renewable and non-renewable resources
- explain the importance of natural resources
- describe the causes of natural resource degradations
- explain the consequences of natural resource degradation
- suggest methods of fixing natural resource degradations

Competencies	*Main Contents*	*Suggested Activities*
Students will be able to: ▪ define natural resource and list its importance ▪ mention the major types of natural resources ▪ indicate the components of natural resources	**10. Natural Resources** 10.1. Definition and importance of natural resources 10.2. Major types of natural resources 10.3. Causes and consequences of degradation of natural resources	▪ At the outset of this unit, you can introduce students with the concepts and major types of natural resource management ▪ Students, individually, are asked to define natural resource and they should list its importance. Students are also asked to list major types of natural resources. ▪ Organize buzz-group so that students discuss on major types and components of natural resources. At the end, let group leaders present the main outcomes of their discussions. You should monitor and encourage group discussions and presentations. Finally, record their group discussion results and provide them timely feedback. As an assessment, you can provide students quiz, test, assignment and final exam.

Theme: **Natural Resources Management**

Unit Eleven: Management of Natural Resources *(6 periods)*

Learning Outcomes: At the end of this unit, students will able to:

- explain the major concepts in use of natural resources
- explain soil management
- describe agricultural water management
- state the importance of forest and wildlife management
- explain environmental management
- identify types of indigenous knowledge applicable to natural resources management practices

Competencies	*Main Contents*	*Suggested Activities*
Students will be able to: ▪ explain soil management ▪ explain agricultural water management ▪ understand importance of forest and wildlife management ▪ explain environmental management ▪ explain climate change and adaptation practices ▪ mention indigenous knowledge's applicable in natural resources management practices	**11.Management of Natural Resources** 11.1. Soil management 11.2. Agricultural water management 11.3. Forest and wildlife management 11.4. Environmental management 11.5. Climate change and adaptation practices 11.6. Types of indigenous knowledge's applicable in natural resources management practices	▪ Students, individually, are asked to define soil management. Students are also asked to state agricultural water management. Plus, pose students to explain the meaning of forest and wildlife management. ▪ Organize buzz-group so that students discuss on climate change and adaptation practices and let group leaders present the main outcomes of their discussions. Students in small groups should mention and discuss on indigenous knowledge's applicable in natural resources management practices. You should always monitor and encourage group discussions and presentations; and provide them timely feedback.

Theme: **Natural Resources Management**

Unit Twelve: Concepts of Biodiversity *(5 periods)*

Learning Outcomes: At the end of this unit, students will able to:

- define biodiversity
- explain values and services of biodiversity
- list threats to biodiversity
- describe forest and wildlife management
- discuss biodiversity conservation
- give informed opinion on the status of biodiversity conservation in Ethiopia

Competencies	***Main Contents***	***Suggested Activities***
Students will be able to: ▪ define the meaning of biodiversity and its scopes ▪ explain values and services of biodiversity ▪ explain threats to biodiversity ▪ clarify forest, wildlife and ▪ environmental management ▪ describe biodiversity conservation and status of conservation in Ethiopia	**13. Concepts of Biodiversity** 13.1. What is biodiversity? 13.2. The scope of biodiversity 13.3. Values and services of biodiversity 13.4. Threats to biodiversity 13.5. Biodiversity conservation and the status of status of conservation in Ethiopia	▪ Students are provided with information on concepts of biodiversity, and asked to define biodiversity and its scopes. ▪ Students are also asked to describe the values and services of biodiversity. Students are also asked to list major types of natural resources. ▪ Organize buzz-group so that students discuss on the threats to biodiversity. At the end, let group leaders present the main outcomes of their discussions. You should monitor and encourage group discussions and presentations. ▪ As an assessment, you can pair up students and give class work on the meaning of biodiversity conservation and the status of conservation in Ethiopia. Let the groups present their discussion points to the class. Finally, record their group discussion results and provide them timely feedback.

Theme: **Natural Resources Management**

Unit Thirteen: Climate Change Adaptation and Mitigation *(5 periods)*

Learning Outcomes: At the end of this unit, students will able to:

- describe climate change and variability
- clarify the effects of climate change
- suggest climate change mitigation strategies
- explain climate change adaptation strategies of Ethiopia
- mention indigenous knowledge in climate change mitigation practices

Competencies	*Main Contents*	*Suggested Activities*
Students will be able to: ▪ define climate change and climate variability ▪ explain climate change and its effects ▪ understandclimate change mitigation strategies ▪ describe climate change adaptation strategies of Ethiopia ▪ mention indigenous knowledge's applicable in climate change mitigation strategies	**13. Climate Change Adaptation And Mitigation** 13.1. Definitions of climate change and its variability 13.2. Climate change and its effects 13.3. Climate change mitigation strategies 13.4. An overviews of climate change adaptation strategies of Ethiopia 13.5. Indigenous Knowledge in climate change mitigation strategies	▪ After providing introductory information on climate change, students are asked to define climate change and climate variability. ▪ Organize buzz-group to ensure that students are discuss on climate change and its effects, mitigation strategies and status of climate change adaption in Ethiopia. At the end, let group leaders present the main outcomes of their discussions. You should monitor and encourage group discussions and presentations. Finally, record their group discussion results and provide them timely feedback. ▪ You should ask students to explain the importance and the types of indigenous knowledge's applicable in climate change mitigation strategies.

Theme: Agricultural Technology

Unit Fourteen: Mechanized Farming *(3 periods)*

Learning Outcomes: At the end of this unit, students will be able to:

- clarify the meaning of mechanize farming
- state the types of farm tools and equipment
- discuss the use of common farm tools and equipment

Competencies	*Main Contents*	*Suggested Activities*
Students will be able to: ▪ explain meaning of mechanized farming ▪ mention the types of farm tools and equipment ▪ elaborate the use of common farm tools and equipment	**14. Mechanized Farming** 14.1. Introduction to mechanized farming 14.2. Types of farm tools and equipment 14.3. Uses of some farm tools and equipment	▪ After providing brief information on issues of agricultural technology, students are asked to explain mechanize farming. ▪ Pair-up students to list out farm tools and equipment. Let them present the main outcomes of their discussions. ▪ Organize buzz-group so that students discuss on the use of common farm tools and equipment. Please, let each group explain to the class. You should monitor and encourage group discussions and presentations. Finally, record their performance and provide them timely feedback.

Theme: Nutrition Sensitive Agriculture

Unit Fifteen: Introduction to Human Nutrition *(5 periods)*

Learning Outcomes: At the end of this unit, students will be able to:

- define basic terms used in human nutrition
- explain nutrients and their functions
- identify food groups and their sources
- discuss food and nutrition security
- explain the malnutrition status in Ethiopia

Competencies	*Main Contents*	*Suggested Activities*
Students will be able to: ▪ define basic terms used in human nutrition ▪ explain nutrients and their functions ▪ state food groups and their sources ▪ discuss food and nutrition security ▪ describe agriculture-nutrition linkage and nutrition-sensitive agriculture ▪ explain the status of malnutrition and its causes in Ethiopia	**15. Introduction to Human Nutrition** 15.1. Definition of basic terms in human nutrition 15.2. Nutrients and their functions 15.3. Food groups and their sources 15.4. Food and nutrition security 15.5. Agriculture-nutrition linkage and nutrition-sensitive agriculture 15.6. Malnutrition and its causes in Ethiopia	▪ After providing basic information on the definition and relevance of human nutrition concepts, students are asked to define basic terms in human nutrition. ▪ Organize buzzes-group so that students explain the six classes of nutrients and their functions. At the end, let each group present the outcomes of their discussions to the whole class. ▪ Pair-up students to classify food groups and their sources, let groups explain to the class. Students are also asked to explain food and nutritional security, the 4 pillars, and causes of food insecurity. ▪ Organize buzz-group to discuss the status of malnutrition in Ethiopia. Let group leaders present the discussion outcomes. Monitor and encourage discussions/presentations; and provide them timely feedback.

Theme: Nutrition Sensitive Agriculture

Unit Sixteen: Diversified Food Production and Consumption *(4 periods)*

Learning Outcomes: At the end of this unit, students will be able to:

- describe role of food diversification and consumption
- describe dietary diversification strategies
- examine nutrient enrichment/modification strategies
- explain the role of indigenous knowledge in nutrition sensitive agriculture

Competencies	*Main Contents*	*Suggested Activities*
Students will be able to: ▪ explain the role of food diversification and consumption ▪ describe dietary diversification strategies ▪ discuss nutrient enrichment/ modification strategies ▪ explain indigenous knowledge and its application in nutrition sensitive agriculture	**16.Diversified Food Production and Consumption** 16.1.Importance of diversified food production 16.2. Dietary diversification strategies 16.3.Nutrient enrichment/ modification strategies 16.4.Indigenous knowledge in nutrition sensitive agriculture	▪ At the outset of this unit, students are asked on the types of food sources and compliment with positive feedback. ▪ Students also asked to explain the importance of food diversification and consumption. ▪ Organize buzz-group to ensure that students are discuss the different dietary diversification strategies. At the end, let each group present the outcomes of their discussions to the whole class. ▪ Organize pair-work to discuss nutrient enrichment/ modification strategies and let groups explain to the class. Monitor and encourage discussions/ presentations; and provide feedback. ▪ Students are also asked to define nutrition sensitive agriculture and then, explain the application of indigenous knowledge in nutrition sensitive agriculture.