Agriculture

For Rwanda Schools

Senior 3

Teacher's Guide

Contents

INTRODUCTION

The rationale behind the Agriculture syllabus review process was to ensure that the syllabus is responsive to the needs of the learners and to shift from the knowledge-based learning to competence-based learning. Competence-based learning allows students to advance based on their ability to master a skill on competence at their own pace regardless of environment. It is tailored to meet different learning abilities and can lead to more efficient student's outcome.

The teacher's guide has been prepared in line with the competence-based curriculum. It is intended to assist the teacher to interpret the topics in the syllabus for quality and effective teaching. The guide has been written to be used together with the Secondary Three (S3) Student's Book. The Secondary Three (S3) competence-based syllabus by Rwanda Education Board 2015, which has been used in developing both the students' book and this teacher's guide has important information in the following areas:

1 Rationale of Teaching and Learning Agriculture

1.1 Agriculture and Society

Agriculture, as both an applied science and art, is the pillar of our economy. It is a composite of rural and urban industries that are structured to produce both raw and value-added material from plants and animals to meet identified consumer's needs. It provides food, fuel, shelter and other possibilities of diverse lifestyles.

Agricultural industries make a significant contribution to Rwanda's economy through investment, employment of skilled workers, consumption of products from other sectors of the economy and exports.

Increasing the knowledge and skills in the majority of Rwandans will, therefore, go to past integration of Agriculture courses, in Basic Education/Ordinary level self-reliance. It will help the learners to have a competence that helps them to develop and view Agriculture as a source of income in the view that arable land, in limited Agriculture courses, is important to resort to modern agricultural techniques in order to increase food production and generate Rwanda's export income.

1.2 Agriculture and Learners

Agriculture is a worthwhile subject because it prepares the learners for real world of work through career pathways like crop production, crop protection, veterinary medicine, rural development, food sciences, rural engineering, agribusiness and agriculture mechanisation. It provides the skills that guide and help the learners to explain all techniques of crop production and animal rearing, both agricultural and animal products processing and preservation.

This course provides students with an understanding of the relationships between production, processing and consumption to enable them to participate in discussion and solve problems facing our society. Thus, the government of Rwanda has encouraged

the market-oriented Agriculture through policies like crop intensification and land use consolidation, one cow for one family, increase the productivity of Agriculture as one of four priorities of rural development in ECPRSII, productive High Value and Market-oriented Agriculture in Vision 2020. To achieve these policies, all sectors are involved including learners who learnt Agriculture courses.

1.3 Competences

Competences are statements of the characteristics that students should demonstrate which indicate they are prepared and have the ability to perform independently professional practises. There are two types of competences, basic and generic.

(i) Basic competences

These competences are the essential knowledge and skills acquired by the learners in relation to the objectives set in the curriculum for each level of learning.

Basic competences are addressed in the stated broad subject competences and in objectives highlighted year on year basis and in each of the units of S3.

They include the following:

- **Literacy** – This include the four essentials of learning a language, which are; reading a variety of text accurately and quickly, expressing of ideas through writing, communicating ideas through speaking and listening carefully for proper understanding.
- **Numeracy** – This involves computing and manipulating mathematic numbers to accomplish task involving calculation measures and estimation. It also involves use of numerical patterns to solve problems related to every activity in management and interpretation of basic statistical data such as tables, diagrams, charts and graphs.
- **ICT and digital competences** – This involves using search engines to retrieve information for leisure business and communicating to enhance learning.
- **Citizenship and national identity** – This involves relating historical, cultural, geographical, heritage of Rwanda with global dimension. It also helps to advocate for a harmonious cohesion society working with people from diverse cultural backgrounds.
- **Entrepreneurship and business development** – This entails decision-making in planning and managing micro-projects and small and medium enterprises, risk taking in business and evaluating resources needed for business.
- **Science and technology** – This involves science and technological skills to solve problems in real life situations and developing curiosity inquisitiveness while researching to explain theories, hypothesis and natural phenomena to draw appropriate conclusion.

(ii) Generic competences:

- **Critical thinking and problem solving skills** – The acquisition of such skills will help learners to think imaginatively, innovatively and broadly to evaluate and find solutions to problems encountered in our surrounding.
- **Creative and innovation** – The acquisition of such skills will help learners to take initiatives and use imagination beyond knowledge provided in classroom to generate new ideas and construct new concepts.
- **Research** – This will help learners to find answers to questions based on existing information and concepts and use it to explain phenomena from gathered information.
- **Communication in official languages** – Teachers, irrespective of being language teachers, will ensure the proper use of the language of instruction by learners. The teacher should communicate clearly and confidently and convey ideas effectively through spoken and written modes by applying appropriate language and relevant vocabulary.
- **Co-operation, inter personal management and life skills** – This will help the learners to co-operate as a team in whatever task assigned to practise positive ethical moral values while respecting rights, feelings and views of others. Perform practical activities related to environmental conservation and protection. Advocate for personal, family and community health, hygiene and nutrition and responding creatively to a variety of challenges encountered in life.
- **Lifelong learning** – The acquisition of such skills will help learners to update knowledge and skills with minimum external support. The learners will be able to cope with evolution of knowledge advances for personal fulfillment in areas that are relevant to their improvement and development.

1.4 Broad competences for the Agriculture Subject

At the end of Senior Three, students should be able to:

- Demonstrate basic knowledge, skills and attitudes that accurately lead him/her to modern farming practises.
- Show the importance of using the good soil with necessary nutrients and knowing its composition and properties.
- Demonstrate the ability to cultivate a variety of crops both subsistence and cash crops.
- Rear and treat domestic animals.
- Comprehend and apply the processes involved from the planting to the harvesting of crops.
- Acquire necessary knowledge and skills in processing, preserving and adding value to agricultural products.
- Appreciating the economic, social and environmental implications of agriculture.

1.5 Cross-cutting Issues

Cross-cutting issues are also referred to as emerging issues. The teacher is required to infuse these issues in learning while teaching for the benefit of the learning.
The competence-based syllabus has integrated eight cross-cutting issues through the various learning activities in the units. These cross-cutting issues are:

(i) Genocide Studies

This provides young people with an understanding of circumstances that led to the genocide. It also brings to the attention the remarkable story of recovery and fosters national unity. It will help the learners to comprehend the role of each individual in ensuring that nothing of the sort ever happens again.

(ii) Environment and Sustainability

This ensures that the young people understand the importance of sustainability as they grow up and become responsible for the world around them. Learners need basic knowledge from the natural sciences, social sciences and humanities to understand and interpret principles of sustainability.

(iii) Gender

This helps to create awareness of the need to accord every individual basic human rights. With good understanding of the principles of gender equality, it is hoped that future generations will ensure that the potential of the whole population is realised.

(iv) Comprehensive Sexuality Education (HIV/AIDS, STIs, Family Planning, Gender Equality and Reproductive Health)

Comprehensive sexuality education which is age-appropriate, gender-sensitive and life skills-based can provide young people with the knowledge and skills to make informed decisions about their sexuality and lifestyle. The learners should be prepared for the transition from childhood to adulthood which has been a major challenge to humanity. Young people should be helped to overcome challenges related to onset of puberty and adolescence so as to avoid teenage pregnancies and sexually transmitted infections including HIV/AIDS.

(v) Peace and Values Education

Peace is critical for any country's economic growth and development. Values form a key element of the strategy for ensuring young people recognise the importance of contributing to the society, working for peace and harmony and being committed to avoiding conflict.

(vi) Financial Education

Financial education makes learning relevant to real life situations. It provides the tools for sound money management practises on earnings, spending, saving, borrowing and investing.

(vii) Standardisation Culture

It helps to develop learners' understanding of the importance of standards as a pillar of economic development. The adoption of the standardisation culture is intended to have an impact upon health improvement, economic growth, industrialisation, trade and general welfare of the people.

(viii) Inclusive Education

It involves ensuring that all learners are engaged in education and that they are welcomed by other students so that everyone can achieve their potential. Inclusive practises embrace every individual regardless of gender or ability including those with learning difficulties and disabilities. To be successful, inclusive education entails a range of issues including teachers' positive attitudes, improvising the learning resources, variation of teaching and learning methods and working together.

1.6 Agriculture and Development of Competences

The national policy document basing on national aspirations identify some 'basic competences' alongside the generic competences that will develop higher order thinking skills and which will help subject learning and application of what has been learned in real life situation.

Through practises, observation and presentation of information during the learning process, the learners develop not only deductive and inductive skills but also communication and co-operation in working groups, tasks management by accomplishing them at set time and correctly, critical thinking while observing demonstrations and doing practises (during field trip, field work and group discussion), skills in trying to make inferences and conclusion.

Also, the group work and co-operative learning of Agriculture promotes interpersonal relations and teamwork.

2 Pedagogical Approaches in the Teaching of Agriculture

The teacher/trainer is required to mainly orient the course delivery in a practical manner. In line with this, the teacher will set student's hand-on activities, organise work groups, experiments and adapts practical activities to climatic constraints. In addition, the teacher will organise field visits recommended in this syllabus.

In groups, the learners apply the agricultural concepts through learning activities. The observation during field visits increases understanding of theoretical courses and the most hands-on activities are made in the school's garden. This will help the student to learn more practically as an aim of competence-based learning.

2.1 Role of Learners

This approach of learning encourages learners to construct the knowledge, skills and attitude either individually or in groups in an acute way.

Learners work on one competence at a time in form of concrete units with specific learners' outcomes broken down into knowledge, skills and attitude.

In practical lessons, learners will work in groups where the availability of apparatus will not permit working individually but they will be encouraged to do simple practises like plot model individually.

2.2 Role of Teacher

The change to a competence-based learning curriculum is about transforming learning, ensuring that learning is deep, enjoyable and habit-forming.

The teacher is no longer an instructor but a facilitator in this new approach of learning. The participation of the learners, during this new approach, facilitates the teacher to evaluate learners' individual needs and expectations.

The teacher identifies the needs of the learners, the nature of learning to be done and the means to shape learning experiences accordingly.

The teacher's role is to organise, coach the learners in the classroom or outside and engage them through participatory and interactive methods. The following are varieties of teaching methods that are used in the teaching of Agriculture. In many cases the methods can be integrated as per the demand of the lesson. The following are suggested methods used in the teaching of Agriculture:

(a) Demonstration

This is a method in which the teacher shows and explains to the learners how to carry out certain procedure. The method is appropriate when a new topic is being handled for the first time. It can also be used when resources are limited.

In this method, the teacher introduces the topic and explains its importance. He/she explains the steps to be taken in carrying out the demonstration and then carries it out as the students watch. The teacher should organise the class in such a way that all the learners are able to see whatever is being done. The learners are then allowed to ask questions. The teacher then selects a learner to carry out the practice. At this point the teacher makes correction if there is need. By the end of the demonstration, the learners will have been exposed to the activity.

(b) Supervised Practice/Activity

This is a method in which the learners are actively involved in the learning process, that is, they learn by doing. Skills and positive attitude in Agriculture are enhanced by involving the learners in practical activities. Proper preparation by the teacher before conducting a practical lesson is very important, as it ensures proper flow of the lesson. The method closely follows a demonstration by the teacher. At the end of the demonstration, the teacher groups the learners and makes sure that each group has the necessary apparatus and materials. Each learner in the group carries out the activity following the steps demonstrated by the teacher. The teacher moves from group to group observing, giving further instructions, correcting and motivating them. Learners

record and discuss their observations. They then give a report of their findings to the class. Lastly, the teacher may allow a concluding discussion at the end of the lesson in which the learners will take summary notes.

(c) Discussion

This is a verbal interaction between learners on a given topic with the teacher acting as a facilitator. This method enhances participation of learners in the lesson. This discussion should be carefully planned, to ensure that it focuses on the lesson objective(s). For this method to be effective, it is important for the teacher to encourage participation by all learners.

The teacher involves learners in the teaching/learning process, by giving them an opportunity to express their opinions and experiences freely on a particular topic. This can be done by a whole class, large groups or small groups. The teacher introduces the topic of discussion and may also give guiding questions orally or written form to the class or the group. Learners are given time to discuss, write down their findings and then report to the whole class. The teacher eventually gives a final conclusion comprising facts about the topic.

(d) Problem Solving

This is a method where learners actively participate in the lesson by putting to use the skills which they have acquired.

In this method, learners are sensitised about an existing problem to be solved. They are encouraged to study the problem through investigations, observations, experiments and making predictions. In this way, the learners use their initiatives and efforts to further understand what the problem is, its origin and where it may lead to, if not solved. Once the learners have studied and understood the problem, they should come up with suggested solutions. Learners discuss the merits and demerits of each suggested solution and make decisions on which solution(s) is best. Once learners have made a decision on the best option of the solution, they are allowed to take action. The teacher may at this point invite experts, depending on the type of action to be taken. Learners should be encouraged to evaluate the outcome of their decision and actions. This evaluation is very important part of the learning process because through it, learners will determine the effectiveness of an action and whether they can apply it in future.

(e) Role Playing

This is an approach that involves acting out particular ways of behaviour in order to learn from a situation. In this method, learners are asked to enact certain characters and situations. This helps to bring out learners' activity and imaginations. The aim of this act is to help learners visualise the real situation. The teacher should be able to select topics that can be taught well using this method. Role plays are different from dramatisation in that they are instantaneous. Learners use their own words and the

role player does not have to put on costumes. It also takes a short time probably 2–5 minutes.

(f) Exhibitions/Agricultural Shows

These are displays which are arranged from time to time and teachers take the opportunity to expose learners to certain information and experiences which would not be found elsewhere. The teacher should also utilise the exhibitors, as resource persons for his/her learners. The teacher should encourage learners to carry writing materials, to record the information displayed in the exhibition. Exhibitions could be school or externally based. When learners come back to class, the teacher should make clarifications and follow up.

An exhibition covers many areas, topic and objectives. Agricultural shows should be treated in the same way as exhibitions.

(g) Project

This is work that is organised or designed to achieve a particular objective. In Agriculture, learners are usually given plots to carry out husbandry practises, which are taught in class. The project can also be in animal production. This method is used to enable the learners practice what they have been taught. The project is fully managed by the learner with minimum supervision by the teacher. However, the teacher provides all the necessary inputs for the project. The project normally takes a long duration from few weeks to many months. A project can also be used for experimental purposes.

(h) Agricultural Field Days

These are organised by extension officers or other agricultural officers for the purpose of demonstrating particular farm practices. The teacher should liaise with the organisers of the field days, in order to take advantage of such opportunities to enhance classroom teaching.

The teacher should:

- Be aware of where the field day is taking place in advance. The field day should be relevant to Agriculture and even to specific topic(s) in the syllabus.
- Make travel and subsistence arrangements.
- Talk about field day to the learners on what they need to carry and how to behave during the field day.
- Develop writing guidelines on what to observe and record.

During the field day, the teacher will either guide or have somebody to guide and explain to the learners.

After the field day, the learners will report on what they observed.

(i) Field Trips

These are organised by the teacher outside the classroom. Trips are organised after covering a large area of syllabus, to emphasise certain agricultural practises. Although the teacher may organise a field trip for the purpose of enhancing the understanding of a particular farm practises, he/she should take the opportunity to point out other important practises along the way. It might also be important for teachers in different subjects, to collaborate in the organisation of such field trips, in order to make it commercial.

Learners should be given a questionnaire during a field trip. A questionnaire is a research instrument which is prepared for the purpose of respondents. It consists of a set of leading questions that help in obtaining information from people for various reasons. In the case of learners questionnaires, the information gathered is used for learning. There are several field trips to be conducted during the course of learning the content for Secondary Three Agriculture. Questionnaires for each field trip have been prepared for the teacher and marked as Annexes attached on pages of this teacher's guide.

A sample questionnaire for a field trip

Part 1: Administrative information: …….

(i) Name of the farm to be visited: …….

(ii) Name of the visiting institution/school: ……..

(iii) Date of travel: ……

(iv) Purpose of the trip: ……..

Part II: Leading questions

These are questions to guide the learners on the specific activities to be carried out, observations to be done and the area of interest. The teacher is required to formulate questions depending on the need of the lesson.

(j) Discovery Method

It is also known as the research method. In this method, learners are given a topic to research on. They are given references of relevant resource materials. They read on their own and prepare a report of their findings. Learners acquire knowledge in the course of the reading. This method is suitable for learners who can work on their own without supervision.

2.3 Special Needs Education and Inclusive Approach

All Rwandans have the right to access education regardless of their different needs. The underpinning of this provision would actually hold that all citizens benefit from the same menu of educational programmes. The possibility of this assumption is the focus of special needs education. The critical issue is that we have persons/learners who are totally different in their ways of living and learning as opposed to the majority.

The difference can either be emotional, physical, sensory and intellectual learning challenged traditionally known as mental retardation.

These learners equally have the right to benefit from the free and compulsory basic education in the nearby ordinary/mainstream schools. Therefore, the school's role is to enroll them and also set strategies to provide relevant education to them. The teacher, therefore, is required to consider each learner's needs during teaching and learning process. Assessment strategies and conditions should also be standardised to the needs of these learners. Detailed guidance for each category of learners with special education needs is provided for in the guidance for teachers.

3 Assessment Approaches

Assessment is the process of evaluating the teaching and learning processes through collecting and interpreting evidence of individual learner's progress in learning and to make a judgement about a learner's achievements measured against defined standards. Assessment is an integrated part of the teaching/learning processes. In the new competence-based curriculum, assessment must also be competence-based, whereby a learner is given a complex situation related to his/her everyday life and asked to try to overcome the situation by applying what he/she learnt.

At ordinary level assessment for agriculture subject will be organised at school and district level to focus on practical skills.

3.1 Types of Assessments

3.1.1 Formative and Continuous Assessment (assessments for learners)

Continuous assessment involves formal and informal methods used by schools to check whether learning is taking place. When a teacher is planning his/her lesson, he/she should establish criteria for performance and behaviour changes of the beginning of a unit. Then at the end of every unit, the teacher should ensure that all the learners have mastered the stated key unit competences basing on the criteria stated, before going to the next unit. The teacher will assess how well each learner masters both the subject and the generic competences described in the syllabus and from this, the teacher will gain a picture of the all-round progress of the learner. The teacher will use one of a combination of the following:

(a) Observation
(b) Pen and paper
(c) Oral questioning

3.1.2 Summative Assessment (assessment for learners)

When assessment is used to record a judgement of a competence or performance of the learners, it serves a summative purpose. Summative assessment gives a picture of a learner's competence or progress at any specific moment. The main purpose of summative

assessment is to evaluate whether learning objectives have been achieved and to use the results for the ranking or grading of learners, for deciding on progression, for selection into the next level of education and for certification. This assessment should have an integrative aspect whereby a student must be able to show mastery of all competences.

It can be internal school-based assessment or external assessment in the form. School-based summative assessment should take place once at the end of each term and once at the end of the year. District will be supported to continue their initiative to organise a common test per class for all the schools to evaluate the performance and the achievement level of learners in individual schools. External summative assessment will be done at the end of S3.

3.2 Record Keeping

This is gathering facts and evidence from assessment instruments and using them to judge the students' performance by assigning an indicator against the set criteria or standard. Whatever assessment procedures used shall generate data in the form of scores which will be carefully recorded and stored in a portfolio because they will contribute for remedial actions, for alternative instructions strategy and feedback to the learners and to the parents to check the learning progress and to advise accordingly or to the final assessment of the students.

This portfolio is a folder (or binder or even a digital collection) containing the students' work as well as the students' evaluation of the strengths and weaknesses of the work. Portfolios reflect not only work produced (such as paper and assignments), but also it is a record of the activities undertaken over time as part of student learning. Besides, it will serve as a verification tool for each learner that attended the whole learning before undergoing the summative assessment for the subject.

3.3 Item Writing in Summative Assessment

Before developing a question paper, a plan or specification of what is to be tested or examined must be elaborated to show the units or topics to be tested on the number of questions in each level of Bloom's Taxonomy and the marks allocation for each questions. In a competence-based curriculum, questions from higher levels of Bloom's Taxonomy should be given more weight than those from knowledge and comprehension level.

Before developing a question paper, the item writer must ensure that the test or examination questions are tailored towards competence-based assessment by doing the following:

- Identify topic areas to be tested on from the subject syllabus.
- Outline subject-matter content to be considered as the basis for the test.
- Identify learning outcomes to be measured by the test.
- Prepare a table of specifications.
- Ensure that the verbs used in the formulation of questions do not require memorisation or recall answers only but testing broad competences as stated in the syllabus.

Structure and Format of the Examination

There will be 3 papers in Agriculture subject and time for each paper will be 45 minutes per trainee or per team of trainees doing the same task (activity). During the 45 minutes, each trainee or team of trainees will be assigned to do practical exercises on which some theoretical questions can be asked to the assessed person. The paper will be structured as follows:

- Paper 1 will be based on Practices of crop production techniques (40%).
- Paper 2 will be based on Practices of animal production techniques (30%).
- Paper 3 will be based on Crop and animal products preservation and processing and principles of Agriculture Economics (30%). All components will be externally assessed and based on 'O' level syllabus content.

Sample Table of Specification for Paper 1: Soil Science and Crop Production Technologies (Out of 40 Marks)

TOPIC AREA	CONTENT UNIT	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	**Total**
SOIL SCIENCE	Soil lessons 12	1	1	3	3	3	2	**13**
CROP AND MUSHROOM PRODUCTION AND PROCESSING	Cereals lessons 8	-	1	2	2	2	2	**9**
	Ornamental lessons 8	1	-	2	2	2	2	**9**
	Fodder lessons 8	2	1	2	2	2	-	**9**
	Total	4	3	9	9	9	6	**40**

Note: The paper to be done in 45 minutes

Explanation on the allocation of marks in the table of specifications

In the table of specification, marks are allocated on the basis of the weight of a unit in

terms of the number of lessons. There are four units (areas) to be tested in this table of specification. These are:

(i)	Soil	:	12	lessons
(ii)	Cereals	:	8	lessons
(iii)	Ornamentals	:	8	lessons
(iv)	Fodder	:	8	lessons

Total : 50 lessons

For a 40 marks paper, the marks would be allocated as follows:

(i)	Soil	:	12/36 x 40	=	13.3 approximately	13 marks
(ii)	Mushrooms	:	8/36 x 40	=	8.9 approximately	9 marks
(iii)	Fruits	:	8/36 x 40	=	8.9 approximately	9 marks
(iv)	Legumes	:	8/38 x 40	=	8.9 approximately	9 marks

The examiner then decides on the types of questions to set based on the Bloom's Taxonomy of educational objectives. Alternatively, table of specification may be prepared for 100% and then the marks reduced to 40% after marking. The same formula may be used for paper 2 and 3.

3.4 Reporting to Parents

The wider range of learning in the new curriculum means that it is necessary to think again about how to share learners' progress with parents. A single mark is not sufficient to convey the different expectations of learning which are in the learning objectives. The most helpful reporting is to share what students are doing well and where they need to improve.

4 Teaching/Learning Resources

To facilitate the implementation of competence-based learning in Agriculture course in this level, several materials/equipment are needed.

A detailed list of didactic materials is found in the footer of each unit writing. Here is mentioned different sources, categories and types of didactic materials. Didactic materials can originate from improvisation by the teacher in close or remote school environment. As far as assist nature is concerned, didactic materials can be non-living materials or physical living, some of which are listed below:

(a) School Field

The school compound forms the most immediate environment from which the teacher can source teaching aids. It can, therefore, be used as a teaching resource to enhance learning.

(b) School Farm

If the school has a commercial farm, it can be used for teaching of Agriculture to enhance learning in units involving animal and crop production and soil science. The

teacher should work closely with those managing the farm in order to have access to the farm. The learners should be closely monitored while in the farm.

(c) Demonstration Plots

These are small-sized plots that the teacher has established for the purpose of enhancing his/her teaching. Income generation is not a priority but any surplus can be sold. They are used by the teacher to demonstrate agricultural practises to the learners before they carry out the activities in their project plots.

(d) Crop Museum

This is an area set aside for growing different crops in small quantities for students' use. The crops planted in the museum are mainly those not commonly found within the locality. Sometimes the teacher may plant such crops so that he/she has specimen within the locality. Each species of planted crop should be well labelled, maintained and used to demonstrate the management practises of crops.

(e) Project Plots

These are run either by individuals, groups of students or the whole class clubs. This is where students practise what they have learnt in class. They should work on their project plots outside class time. The Agriculture teacher should make constant assessment of the work. It is in these plots that students carry out any practical activities in the Students' Book 3.

(f) Farm Inputs

Farm inputs can be useful teaching/learning resources. They are categorised into variable and fixed inputs. The variable inputs include fertilisers, herbicides, pesticides, seeds or planting materials, livestock feeds and casual labour. The fixed inputs include: Land, machinery, permanent labour, tools and equipment.

(g) Neighbouring Farms

These are farms close to the school which the teacher can use to enhance the learning process. Teachers can take their learners to see a well-managed ruminant shelters, a crush, orchards, farm animals, irrigation systems, mushroom cultivation and others.

(h) Community Resources

The surrounding community can offer useful teaching/learning resources for Agriculture. Some of these include: Cattle dips, co-operatives and markets.

(i) Agricultural Shows/Field Days/Exhibitions

Shows, field days and exhibitions offer important learning/teaching opportunities. Shows and field days organised by the National Agricultural Export Development Board (NAEB) for the local communities provide good learning resources for the

teacher because they provide valuable learning opportunities. The learners are able to observe exhibit items which may have been taught in class. Learners are also exposed to experts who explain various agricultural processes and principles, and learn through enquiry.

(j) Agricultural-based Industries

These can be used by the teacher to strengthen what has been taught. Examples of such industries include: Fruit processing, dairies and slaughter houses, where teachers can organise for learners to visit.

(k) Guest Speakers

These are resource persons who are knowledgeable in Agriculture and related fields. They can be invited to schools to demonstrate certain practices in the curriculum.

(l) Printing Materials

These are very important sources of information because they are readily available and can be used directly by teachers and students. They include text books, magazines, academic articles and newspapers. They are found in the school libraries.

(m) Audio-visual Aids

These resources can be audio, visual or audio-visual. They are either prepared by the teacher or pre-prepared. Some are easily used directly by learners while others require some equipment to assist in their use.

The teacher must either be able to use the equipment or have somebody who is conversant with their usage to assist. Resources in this group should be handled with care and kept safely as they are expensive. Such resources include: Films, videos, television, radio, audio tapes, slides, photographs, laptops, desktops, tablets and charts.

(n) Human Resource

The effective implementation for this syllabus needs a joint collaboration of educators at all levels. Given the materials requirements, teachers are expected to accomplish their noble role as stated above. However, teachers should be equipped with a strong pedagogical content knowledge (PCK) and enough teaching experience. Furthermore, a science and elementary technology teacher should be creative and able to improvise since many of teaching aids can be found around the school and hand-made by the teachers themselves.

On the other hand, school headteachers and directors of studies should be trained on the use of competence-based syllabus then they will be able to make a follow-up and assess the teaching and learning of this subject due to their profiles in the schools. These combined efforts will ensure bright future careers and lives for learners as well as the contemporary development of the country.

4.1 Skills required for the Agricultural Teacher

Ability to:

- Engage learners in variety of learning activities.
- Use multiple teaching and assessment methods.
- Adjust instructions to the level of the learner.
- Be creative and innovative.
- Make connections/relations with other subjects.
- Instill discipline to the learners.
- Organise and manage the class.
- Communicate well.
- Guide and counsel the learners.
- Have passion for teaching and supervising learning.
- Have a high level of knowledge of the subject content.

5.0 Syllabus Units

5.1 Presentation of the Structure of the Syllabus Units

Agriculture subject is taught and learned in lower secondary education as an elective subject. At every grade, the syllabus is structured in Topic Areas, and then further broken down in units. These units have the following elements:

1. Unit is aligned with the Number of Lessons.
2. Each Unit has a Key Unit Competence whose achievement is pursued by all teaching and learning activities undertaken by both the teacher and the learners.
3. Each Unit Key Competence is broken into three types of Learning Objectives as follows:
   (a) Type 1: Learning Objectives relating to Knowledge and Understanding (Type 1 Learning Objectives are also known as Lower Order Thinking Skills or LOTS)
   (b) Type II and Type III: These Learning Objectives relate to acquisition of skills, Attitudes and Values (Type II and Type III) Learning Objectives are also known as Higher Order Thinking Skills or HOTS) – These learning objectives are usually considered to be the ones targeted by present reviewed syllabus.
4. Each Unit has a Content which indicates the scope of coverage of what a teacher should teach and learner should learn in line with stated learning objectives.
5. Each Unit suggested Learning Activities that are expected to engage learners in an interactive learning process as much as possible (learner-centred and

participatory approach).

6. Finally, each Unit is linked to other subjects, its Assessment Criteria and the Materials (or Resources) that are expected to be used in the teaching and learning process.

In all, the syllabus of Agriculture for 'O' level has got 4 Topic Areas (Soil Science, Crop Production and Processing, Animal Production and Agriculture Economics). As for the units, they are 7 in S1, 7 in S2 and 8 in S3.

CONTENT MAP

Unit 1	**Soil**
Number of Periods	**12**
Key unit competence	The learner should be able to identify types, causes, factors and effects of soil erosion and carry out soil conservation practices.
Number of lessons	**7**
Equipment, learning and teaching materials required	• Computers, laptops, internet, videos, newspapers, magazines, charts, school library. • Student' Book S3 Agriculture. • School farm, neighbouring farms and eroded areas. • Community erosion control structures, road constructions. • Tape measures, garden lines, rectangular frames, A-frames (triangular frames), transparent water hose levels, carpenters level, pegs, timber, mesh wire, hammers, mattock, hand hoes, shovels.

Activities/ techniques	• Finding out the meaning of soil erosion. • Field visit to observe and find out signs of erosion in the area and identify types of eroded soils. • Field visits to observe and identify causes of soil erosion. • Finding out the factors affecting soil erosion. • Finding out the effects of soil erosion. • Finding out the factors that cause soil exhaustion. • Field visit to observe hill sides protected against erosion and to identify cultural measures of soil conservation. • Field visit to observe and identify mechanical methods of soil conservation. • Making and using A-frame and a transparent water hose level to mark contour lines on a slopy area. • Constructing terraces, ridges, bunds and diversion channels. • Constructing anti-erosive ditches and stone lines. • Establishing a grass filter strip, trash line and constructing a gabion.
Generic competences practised	• Critical thinking and problem-solving skills. • Creativity and innovation. • Research. • Communication in official languages. • Co-operation, interpersonal management and life skills. • Life long learning.

Cross-cutting issues to be addressed	• **Environmental sustainability:** Provide learners with practical skills on how to control soil erosion by participating in constructing soil erosion control structures. • **Gender:** Involve all learners in practical activities regardless of their gender. • **Peace and value education:** Values and skills imparted in this unit make the young people realise their importance and contribution in the society. They work together peacefully and in harmony in practical activities such as building gabions for the communities around them and this helps them avoid conflicts. • **Inclusive education:** All learners will be engaged in activities of their own abilities in soil erosion control. Learners with special needs will be integrated into activities which they can manage such as collecting of trash and arranging of stones. This brings on board every individual regardless of special needs, ability and gender.
Assessment Strategies of the key unit competences	• Competence in practical work. • Formative assessment questions and Revision Questions. • Continuous assessment test. • Summative evaluation.

Unit 2	Cereals
Number of Periods	**8**
Key unit competence	• The learner should be able to conduct cultivation of cereals.
Number of lessons	**5**
Equipment, learning and teaching materials required	• Cereal seeds • School fields • Hoes • Computer laboratory with internet • Small farm tools • Textbooks • Note books • Pens • Questionnaire • Magazines showing cereals
Activities/techniques	• Field visit to areas growing cereals to observe the characteristics of cereals. • Finding out the types of cereals cultivated in Rwanda. • Finding out the importance of cereal crops. • Field visit to conduct cultural practices of cereals by demonstration.
Generic competences practised	• Critical thinking and problem solving skills. • Research. • Co-operation, interpersonal management and life skills.

Cross-cutting issues to be addressed	• **Gender:** The unit is relevant to even the cultural ways of producing crops. Everyone should appreciate and engage in the learning of production of cereals which brings equity and increased production. • **Peace and value education:** Working together, listening, participating in group work, discussions, report writing helps to avoid conflicts. • **Standardisation culture:** It is important that the adoption of a standardisation culture to improve the health through production of high quality cereals, economic growth on improved yield and better use of technology and improvement of sustainable economic development leads to wealth creation.
Assessment strategies of key unit competences	• Formative assessment in the course and summative evaluation in the course of this unit.

Unit 3	Ornamentals
Number of Periods	**8**
Key unit competence	The learner should be able to conduct a cultivation of a range of ornamental plants.
Number of lessons	**5**
Equipment, learning and teaching materials required	• Students' course book 2 Agriculture. • School farm, neighbouring. • Ornamental seedlings. • Library. • Internet. • Grafting tools. • Other small tools such as pruning knife, secateurs and loopers.
Activities/ Techniques	• Finding out the measuring of ornamentals. • Field visit to observe and explore ornamental plants grown in Rwanda. • Finding out the importance of ornamental plants grown in Rwanda. • Watching video showing methods of propagating ornamental plants. • Field visit to conduct cultural practices of Rose plants. • Conducting cultural practices of Duranta and Palm trees. • Conducting cultural practices of Anthurium. • Conducting cultural practices of Bougainvillea.
Generic competences practised	• Critical thinking and problem solving skills • Research.

Cross-cutting issues to be addressed	• **Standardisation culture:** The unit develops learners' understanding as a pillar of economic development. The activities that they carry out in this unit should be done accurately to standard especially when they are able to use measurement equipment such as spirit level, A-frames and others. They will aim at becoming citizens of high lifestyles.
Assessment strategies of the key unit competence	A formative assessment in the course of the unit and a summative evaluation at the end of the unit.

Unit 4	**Fodder**
Number of Periods	**8**
Key unit competence	The learner should be able to successfully conduct cultivation of fodder grasses.
Number of lessons	**5**
Equipment, learning and teaching materials required	• Fodder grass cuttings, fodder grass seeds, fertilisers and manures. • Hand hoes, machetes and other small farm tools, wheelbarrow, land for planting. • Computers, internet, laptops, videos, newspapers, magazines, school library, Students' Book 3 Agriculture. • Tape measure, garden line.

Activities/ techniques	• Finding out the meaning of fodder grasses. • Field visit to explore fodder grasses cultivated around the school. • Finding out the importance of fodder. • Finding out the propagation methods of fodder grasses. • Carrying out cultural practices in Napier grass. • Carrying out cultural practices in Guatemala grass and para grass (*Brachiaria mulato*). • Carrying out cultural practices in growing maize and sorghum. • Carrying out cultural practices in growing fodder oats and pearl (bulrush) millet.
Generic competences practised	• Critical thinking and problem solving skills. • Research. • Communication in official languages.

Cross-cutting issues to be addressed	The emerging issues addressed by this unit are as follows: • **Peace and value education:** When young people live in a peaceful atmosphere, they are able to acquire value education which help them to contribute to society by bringing peace and harmony to avoid conflict. Carrying out these practices together help the learners see each others' achievement and contribution to the success of the group. • **Environmental and sustainability:** This unit helps the learners to be competent in sustaining soil fertility when they grow fodder grasses. This maintains the environment as well as produce food for livestock to avoid overgrazing which brings environmental degradation. • **Inclusive education:** Working together in groups when carrying out production of fodder grasses helps each individual to participate and contribute to the welfare of the group. Each individual has a part to play regardless of their gender or ability. • **Standardisation culture:** Learners understand the importance of standards as a pillar of economic development. Using accurate measurement, spacing and seed rate in fodder production help learners to maintain high standards in production and will always aim at achieving high standards in future.
Assessment strategies of the key unit competences	• Competence in practical work. • Formative assessment. • Summative assessment.

Unit 5	Animals
Number of Periods	**8**
Key unit competence	• The learner should be able to recognise fish species by their characteristics and make successfully a bee hive.
Number of lessons	**6**
Equipment, learning and teaching materials required	• Pictures of fish, library books, computers, internet and computer laboratory, textbooks. • Raw materials; iron sheets, timber, nails, wires, posts and platforms. • Small workshop tools such as claw hammer, wood chisel and hand saws and tenon saws.
Activities/ techniques	• Observing and identifying fish species using their anatomical characteristics. • Finding out the selection criteria of suitable species of fish to rear. • Finding out the definition and the importance of bee keeping. • Field visit to an apiary to observe and find out the different categories of bees and their characteristics. • Finding out the materials required for making beehives. • Constructing the top bar hive. • Field visit to a farm with an apiary to carry out beehive management practices. • A field visit to an apiary to harvest honey.
Generic competences practised	• Critical thinking and problem solving skills. • Research. • Communication in official languages. • Co-operation, interpersonal management and life skills.

Cross-cutting issues to be addressed	• **Gender:** When working together in construction of soil erosion control structures, the learners appreciate the need to treat every individual equally. Boys and girls carry out the same tasks equally. • **Standardisation culture:** The activity that the learner carries out in this unit should be done accurately to standards especially when they are to construct beehives like the top bar hive using right dimensions.
Assessment strategies of the key unit competences	• Competence in practical work such as feeding bees and selecting correct fish species. • Formative assessment. • Summative assessment.

Unit 6	**Animals**
Number of Periods	**12**
Key unit competence	• The learner should be able to successfully conduct a rearing of poultry and pigs.
Number of lessons	**7**
Equipment, learning and teaching materials required	• Computers, laptops, videos, internet, newspapers, magazines charts, school library. • Students' Book S3 Agriculture page 289. • School farm, neighbouring farms. • Aviary, piggery, timber, bricks, cement, water, sand, ballast, nails, hinges, screws, bolts, iron sheets, electric wiring materials. • Diseased birds, and pigs drugs, parasites both internal and external, drugs used to treat pigs and poultry disinfectants, syringes and needles, drenching guns. • Pig concentrate feeds for all ages, poultry concentrate feeds for all ages and for layers and broilers.

Activities/ techniques	• A field visit to a non-ruminant farm (poultry and pigs) to observe shelters, materials they are made of and how they are arranged. • Finding out the type of materials used to construct aviary and pigsty and how they are arranged. • Constructing a standard aviary and pigsty. • Field visit to a poultry and pig farm to find out their feeding and feeding plans. • Finding out feed diet given to pigs. • Finding out feed diet given to poultry. • Pig feeding according to the development stage. • Making feeding plans and feeding poultry according to stage of development, species and breed. • Field visit to poultry and pig farms to find out enemies of pigs and poultry and how they are controlled. • Finding out the diseases of pigs, their causes, symptoms, damages and control measures. • Finding out diseases of poultry, their causes, symptoms, damages and control measures. • Farm visit to a poultry and pig farm to practise hygiene measures.
Generic competences practised	• Critical thinking and problem solving skills. • Research.

Cross-cutting issues to be addressed	• **Gender:** Both boys and girls take part in construction of animal structure, feeding and maintaining health in the farm. This enables them understand the importance of gender equality. • **Peace and value education:** When focusing on the contribution to the construction of pig and poultry structures, the learners recognise the importance of working in harmony and peace to avoid conflict. • **Standardisation culture:** Learners are able to maintain standards in feeding poultry and pigs, and keeping them healthy. This helps them to understand that keeping standards is an economic pillar towards development and sustainable future. • **Inclusive education:** Inclusive practicals in this unit helps learners to welcome and appreciate each other regardless of their gender ability including those with learning difficulties so that all can benefit.
Assessment strategies of the key unit competences	• Practical work competency. • Formative assessment in this book. • Continous assessment tests. • Assignments. • Summative evaluation of this book. • Revision questions at the end of this unit in Students' Book 3 Agriculture. • Group work and projects.

Unit 7	Integrated Livestock-Fish Farming
Number of Periods	**14**
Key unit competence	The learner should be able to successfully run and manage an integrated fish farm.
Number of lessons	**9**
Equipment, learning and materials required	• Fish ponds. • Videos. • Pictures or charts of integrated-fish farming systems. • Construction materials such as cement, wood, iron sheets and nails. • Farm tools such as hoes, *pangas* and a claw hammer. • Projector. • Different ingredients of fish diet.
Activities/ techniques	• Finding out the meaning of integrated livestock-fish farming. • Finding out the importance of integrated fish farms. • Field visit to an integrated livestock-fish farm to observe types of integrated fish farming systems. • Field visit to an integrated fish farm to observe and identify integrated livestock-fish shelters and their construction materials. • Finding out the materials used to construct integrated livestock-fish shelters. • Constructing a standardised integrated livestock-fish pond. • Managing and maintaining an integrated livestock-fish infrastructure. • Field visit to an integrated livestock-fish farm to observe fish foods and fertilisation of fish ponds. • Finding out the meaning of pond fertilisation. • Feeding fish. • Finding out the pond enemies and their possible control measures. • Watching a video on different diseases of fish and their characteristics. • Carrying out fish pond sanitation measures in an integrated livestock-fish farm.
Generic competences practised	• Creativity and innovation. • Critical thinking and problem solving skills. • Research. • Communication in official languages. • Co-operation, interpersonal management and life skills. • Life long learning.

Cross-cutting issues to be addressed	• **Environment and sustainability:** The teacher should sensitise the learners on the importance of conserving the environment for the sustainability of agricultural production. • **Standardisation culture:** The teacher to inculcate in the learners the importance of standards in whatever they are doing as a pillar of economic development. • **Peace and value education:** The teacher should sensitise the learners on the importance of peace in economic growth and development. Without peace, there cannot be any economic activities going on and this leads to poverty. • **Financial education:** The teacher should sensitise the learners on the need for sound financial management to real life situations especially in the area of spending, saving, borrowing and investing.
Assessment strategies of the key unit competences	• A formative assessment in the course of the unit and a summative evaluation at the end of the unit.

Unit 8	**Co-operative Farming**
Number of Periods	**2**
Key unit competence	The learner should be able to explain farming and its contribution to agro-economic problem solving in Rwanda.
Number of lessons	**2**
Equipment, learning and teaching materials/ required	• Computer room with internet connection. • Library books. • Dictionaries. • Textbooks. • Magazines and handbooks for co-operatives.
Activities/ techniques	• Finding out the importance and values of co-operatives in production growth in Rwanda. • Identifying types of co-operatives based on their goals. • Finding out the principles of co-operatives. • Finding out the factors that contribute to the success of co-operatives.

Generic competences practised	• Critical thinking and problem solving skills. • Research.
Cross-cutting issues to be addressed	• **Gender:** One of the principles of co-operatives is equality. When learners understand this principle, they will appreciate and treat one another as equals irrespective of gender. • Peace and value education: the learners will understand the relationship between peace and economic growth.
Assessment strategies of the key unit competences	• Formative assessment in the course of the unit and a summative evaluation at the end of the unit.

SAMPLE LESSON PLAN

School Name..... Teacher's Name .....

Term	**Date**	**Subject**	**Class**	**Unit No.**	**Lesson No.**	**Duration**	**Class Size**
	– / – 2018	**Agriculture**	**S3**	**3**	**3/8**	**40 min**	**40**
Type of special Education Needs to be catered for in this lesson and number of learners in each category				**Visual Impairment (2):** Allow the learners to sit in such a way that they can see the teacher's facial expression and gestures.			
Unit Title	**Ornamentals**						
Key Unit Competence	The learner should be able to conduct cultivation of a range of ornamental plants						
Title of Lesson	Importance of ornamental plants						
Instructional Objectives	Provided with a variety of flowers, learners should be able to point out five benefits of ornamental plants accurately.						
Plan for the class(Location in/outside	Inside the classroom						

<table>
<tr><td>Learning materials for all learners</td><td colspan="3">Ornamental seedlings, library and Internet</td></tr>
<tr><td>References</td><td colspan="3">• Rwanda Education Board; 2015; Agriculture syllabus for ordinary level, S1 – S3.
• REB, Agriculture for Rwanda schools, Secondary Student's Book 3 page 122-184.
• Internet (web:homeguides.sfgate.com/uses – ornamental)</td></tr>
<tr><td rowspan="2">Timing for each step</td><td colspan="2">Description of Teaching and Learning activities. The teacher to divide the learners into groups, supervise and assist them to discuss the importance of ornamental plants. The teacher to give the learners time to present their finding. The learners to work in groups and find out the importance of ornamental plants and present their findings. The teachers consolidates the presentations. The teacher will conclude the lesson by asking the learners to give the importance of ornamental plants as a way of assessing whether the learning process was successful.</td><td rowspan="2">Generic competences and cross-cutting issues to be addressed and a short explanation</td></tr>
<tr><td>Teacher's Activity</td><td>Learners Activities</td></tr>
<tr><td>Introduction

5 minutes</td><td>Review of the field visit to observe and explore ornamental plants grown in Rwanda by asking probing questions.
Possible Questions
(i) Name three ornamental plants identified during the field trip.
(ii) Give one unique feature of Anthurium identified.</td><td>Learners respond to the questions.

Possible answers
(i) Roses, Duranta, Palm trees, Anthurium and Bougainvillea
(ii) Heart shaped leaves
• An inflorescence (spadix) born on a fleshy stem axis
• Brightly (red) coloured bracks known as spathe</td><td>Enviromental and sustainability
• Learn how ornamentals help to control soil erosion.
• How ornamentals help to sustain livelihood when exported.</td></tr>
</table>

Developments of the lesson 30 minutes	• Teacher provides relevant reference materials to each work group. • Teacher asks the learners to find out the importance of ornamental plants using the references materials provided and computers is part of the materials provided. • Teacher supervises the discussions. • Each group to present their findings and consolidate them.	• Learners receive reference materials in groups. • Learners discuss the importance of ornamental plants and record their findings. • Learners present the following possible answers: (i) Adding beauty/ have aesthetic value. (ii) Fragrance / have nice smell or aroma. (iii) Attract wildlife (iv) Cleaning the air especially for indoor plants. (v) For ceremonial and religious use.	**Communication skills** • Working in groups gives the learners an open forum for discussion and contributing information by each learner which facilitates the development of communication skills. **Co-operation/ Teamwork** • Working in groups in terms of sharing tasks such as manipulating the computers and books, recording the results, leading the groups activities and presenting the group findings promotes team spirit, critical thinking and problem-solving.

Conclusion **Summary** **5 minutes** **Assessment**	• The teacher guides learners to summarise the lesson by asking the learners to name five benefits of ornamental plants. • The teacher asks questions on the importance of ornamental plants and tells the learners to write the answers in their exercise books.	The learners respond to the summary question. **Possible answers:** Importance of ornamental plants • Adding beauty to our environment. • Producing sweet smell/fragrance. • Attracting wildlife. • Cleaning the air. • For ceremonial and religious use.	**Life long Education** • Learners will appreciate the need for continuous learning. **Peace and values** • When using computers and library books to find out the importance of ornamentals learners share the resources and reference materials and these fosters peace and values among themselves.
Teacher's self evaluation	All learners are able to recognise the importance of ornamental plants because every individual learners' needs have been catered for.		

Unit 1 Soil

1.0 Key Unit Competence

Learners should be able to identify types, causes, factors, effects of soil erosion and carry out soil conservation practises.

1.1 Prerequisite knowledge and skills

Learners should have knowledge in soil formation, properties and types of soil, characteristics of fertile soils, inorganic and organic fertilizers.
Geometry knowledge from mathematics, classification and diversity of plants from Biology and knowledge of soil catena and types from Geography.

1.2 Cross-cutting issues to be integrated in the teaching and learning activities

The following are the emerging issues addressed by this unit:

(i) **Environmental and sustainability:** When learners will measure contours and construct terraces and ditches for soil conservation in lesson 6 and 7, it will help them to carry out sustainable farming in future to produce food for the people of Rwanda and cater for import.

(ii) **Gender:** When working together in construction of soil erosion control structures, in activities found in lesson 6 and 7 the learners appreciate the need to treat every individual equally. Boys and girls carry out the same tasks equally.

(iii) **Peace and values education:** While carrying out the activities that involves hands on (lesson 6 and 7), learners may work in peace as they are using tools and materials that may injure other classmates.

(iv) **Inclusive education:** All learners will be engaged in activities of their own abilities in soil erosion control. Learners with special needs will be integrated into activities which they can manage such as collecting of trash and arranging of stones. This brings on board every individual regardless of special needs ability and gender.

1.3 Generic competences:

- **Critical thinking and problem solving skills** – In lesson 6 and 7, learners will think imaginatively and broadly to evaluate and find solutions to problems encountered in our surroundings while constructing various measures for soil conservation during a field trip.
- **Creative and innovation** – The acquisition of such skills will help learners to

take initiatives and use imagination beyond knowledge provided in classroom to generate new ideas and construct new concepts.

- **Research** – Learners will develop research skills by using information found on the Internet or library as indicated in lesson 4.
- **Communication in official languages** – Teachers, irrespective of being language teachers, will ensure the proper use of the language of instruction by learners. The teacher should communicate clearly and confidently and convey ideas effectively through spoken and written modes by applying appropriate language and relevant vocabulary.
- **Co-operation, inter personal management and life skills** – In lessons 2,3,4,5 and 6 through discussions of learners within groups, they will co-operate and respect rights, feeling and views of others and respond creatively to a variety of challenges encountered in life.
- **Lifelong learning** – The acquisition of such skills will help learners to update knowledge and skills with minimum external support. The learners will be able to cope with evolution of knowledge advances for personal fulfillment in areas that are relevant to their improvement and development.

1.4 Key terms

1. **Bund:** A ridge of earth placed in a line along the contour run-off and soil erosion.
2. **Contour:** A line joining all places of the same height above sea level.
3. **Ditch:** A long narrow trench or channels.
4. **Controlled grazing:** Livestock grazing limited to specific area.
5. **Infiltration:** The seepage of water into the soil.
6. **Perennial:** A plant that grows for more than one year.
7. **Run-off:** Rainfall or other type of water that does not infiltrate into the soil but flows across the surface.
8. **Ridge:** A long raised strip of earth.
9. **Shrub:** A woody plant that remains less than 10 metres tall and produces shoots or stems from its base.
10. **Water shed:** A unit of the landscape that consists of all the drainage area and channels contributing to a single stream or river.
11. **Slope:** The inclination or angle of the land surface which can be measured as a percentage or in degrees.
12. **Soil capping:** This is the formation of a hard crust on the soil surface that limit permeability of water.

13. **Overland flow:** The flow of water on the surface of the land that occurs after a storm.
14. **Cropping systems:** The order in which the crops are cultivated on a piece of land over a fixed period of time.
15. **Infrastructure:** The basic physical systems that provide services such as transport, communication, water and sewerage.
16. **Desertification:** Transformation of land which was once suitable for agriculture into arid and barren.
17. **Microbial activities:** Activities of the micro-organism such bacteria, fungi, protozoa and viruses in the soil.
18. **Barren land:** A piece of land that is unable to support the growth of crops or toxic substances.
19. **Pollution:** Introduction of contaminants or toxic substances that cause adverse change into the natural environment.
20. **Siltation:** The process by which water becomes dirty as a result of fine mineral particles in water.
21. **Windward side:** Towards the direction from which the wind blows. The side which faces the prevailing wind.
22. **Leeward side:** The side which is sheltered from the prevailing wind.
23. **Barrier:** an obstacle that prevents movement or access.
24. **Diversion dykes:** A temporary ridge of soil constructed at the top of a cut fill slope to divert over land flow from a small area away from unstable slope.
25. **Run-off:** Part of rain water which runs over the surface of an area or land to reach a stream of a water body.
26. **Sedimentation:** Depositing of small solids such as soil particles.
27. **Water way:** A natural or artificial water course or channel for the flow of water.
28. **Agro forestry:** Growing woody perennials under the same land with agricultural crops and pastures for livestock.
29. **Kinetic energy:** Energy possessed by moving objects.
30. **Wood staves:** A vertical wooden post or plank in a building or other structures. It is also known as staff.

1.5 Guidance on problem statement (page 2 of Student's Book):

(a) Divide the learners in groups and instruct them to discuss the problem shown by the photograph on page 2 of the students' book.
(b) Guide the learners to identify the problem as soil erosion.
(c) Help the learners propose possible solutions to the problem which has occurred such as:
    (i) Use of mulching materials in between the rows of maize.
    (ii) Intercropping maize with a cover crop.
    (iii) Use of strip cropping, where maize is grown with alternating grass strips.
(d) Ask the groups to present their findings in the class.

When the rainfall fell, all the crops were washed away to the hillside and consequently the production went down. The farmer calls up on you for help. Analyse the photo and identify the problem that may have occurred on the field. Propose possible solutions to the problem.

1.6 Suggestions for accommodating Special Education Needs (SEN)

It is important for the teacher to identify any special need of learners in the class and help them to cope with the teaching/learning activities to help them get maximum benefits.

The teacher's support for special needs can be summarised as shown below:

	Types of impairment	**Support for the learner**
(i)	**Sensory impairment (visual)**	• Use accommodative visual aids such as large prints. • Allow the learner to sit near the chalk/ white board. • Give them more time to type in case of brail and enough space for the braille machine. • Tag them to visual learners in case of practical activities that require movement.

	Types of impairment	Support for the learner
(ii)	**Sensory impairment (hearing)**	• Allow the learner to sit close to the teacher. • Give them remedial teaching which is one on one. • Speak loudly. • Make arrangements to acquire hearing devices.
(iii)	**Motor impairment**	• Assign them to others for assistance during movements. • Adopt activities they can be able to perform. • Increase their space in the class to accommodate wheel chairs, crutches and others in case they are using them.
(iv)	**Gifted or talented learners**	• Assign them more tasks such as collecting the materials required for the practicals. • Assign them to assist the special needs learners in their groups. • Give them extra work such as writing reports for the group during group discussions.
(v)	**Slow learners**	• Give them extra time to complete their tasks. • Assist them individually during the practical activities. • Attach them to the talented learners.

1.7 List of lessons:

Lesson no	No. of periods	Weeks	Lesson title
1	1	Week 1	Types of soil erosion
2	2	Week 1 & 2	Causes of soil erosion
3	1	Week 2	Effects of soil erosion
4	2	Week 3	Factors causing soil exhaustion

Lesson no	No. of periods	Weeks	Lesson title
5	2	Week 4	Prevention methods of soil erosion control
6	2	Week 5	Various measures of soil conservation
7	2		End unit assessment

1.8 Unit Summary

Soil erosion is the gradual removal of the top soil through the action of water, wind, animals and human beings.

The eroded soil is finally deposited into water bodies and reservoirs causing siltation and reduction in water storage capacity. Soil erosion is accelerated by the following factors: Rainfall of high intensity, steep slopes, lack of vegetation cover or bare ground, loose shallow soils, poor farming practices and wind of high velocity.

Soil erosion leads to desertification and loss of soil fertility hence land becomes barren in terms of agricultural production. In addition, soil exhaustion may occur as a result of overcropping, leaching, overgrazing and burning of organic matter.

However, soil erosion can be prevented using cultural and mechanical measures. Cultural measures used to prevent soil erosion include use of good practices such as crop rotation, mixed cropping, mulching, weeding, contour farming, strip cropping and controlled grazing.

Mechanical methods also referred to as physical or structural measures of controlling soil erosion include terracing, ridging, construction of graded bunds, diversion channels, anti-erosive ditches, stone lines, filter strips and gabions of porous dams.

When soil conservation measures are carried out, soil erosion is controlled. Less soil erosion means better soil quality with soil retaining nutrients which naturally lead to better and more improved crop yield. Erosion control also reduces expenses incurred in drainage and water filtration. It prevents long-term damage to the environment.

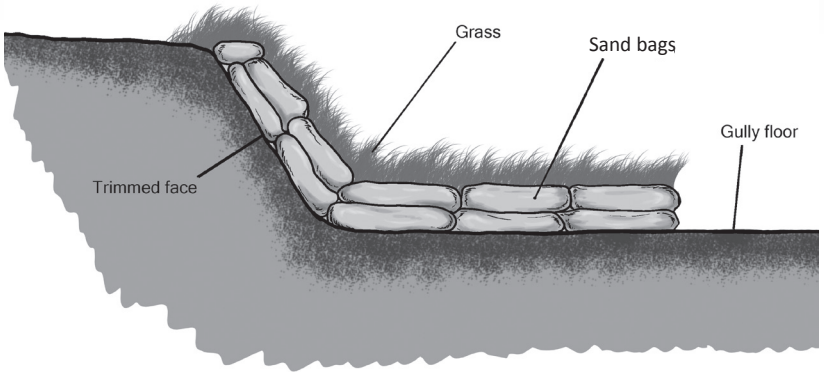
1.9 Additional information for the teacher

Other methods of controlling gully formation

Apart from the construction of gabions or porous dams to control gully formation, the following methods can be used:

(i) Use of correctly designed and constructed conservation works such as storm drains. These structures are dug along the highest point of the farm to divert storm water which would otherwise flow onto the land. Storm drains protect all the structures below it.

(ii) Sandbag pitching: In this method the vertical face of the head of the gully is trimmed. Sandbags are then half-filled with fertile soil and arranged down the face on to the floor of the gully. Grass is then planted on the sand bags.



Other types of soil erosion

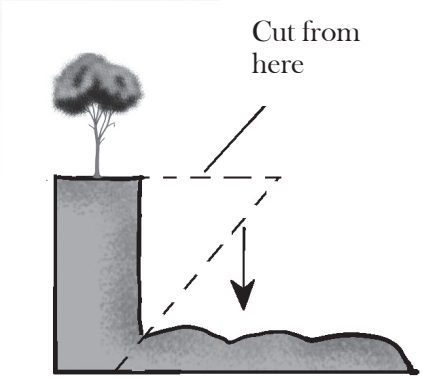
(a) Riverbank erosion: This is the process where fast moving water wears off the sides and the bed of the river leading to widening and deepening of the river. The river increases its width through lateral erosion, its length through headward erosion and its depth through vertical erosion. This reduces land available for farming, carries away crops or trees planted along the banks and the widening destroys structures such as bridges.

(b) Mass movement of soil: Mass movement is also referred to as mass wasting. It is the movement of masses of bodies of soil bed rock, rock debris or mud which usually occurs along steep-sides hills and mountains. It is due to the pull of gravity. The slipping of large amounts of rock and soil is seen in landslides, mud slides or avalanches.

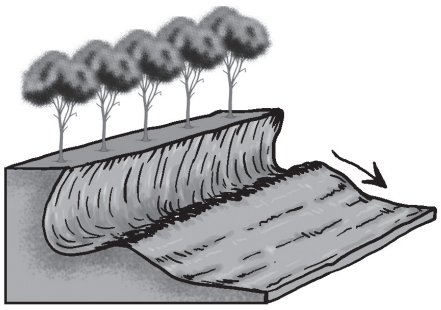
Landslides: This is a sudden landslip down the slope where rocks and soil debris detaches itself from the rest of the land and fall downwards. Landslides are caused by the lubricating action of water and pull of gravity.

Forms of land-slides:

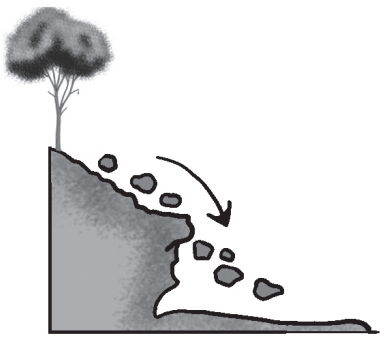
- **Debris fall:** This is the movement of materials along an overcharging cliff. It is also common along an under-cut bank of a river.
- **Debris slide:** Materials slide down the slopes towards the lower areas. These may produce devastating effects.
- **Rock fall:** Individual rocks may fall from top of the cliff to the valley below.
- **Rock slide:** Rock materials may slide down into the valley.



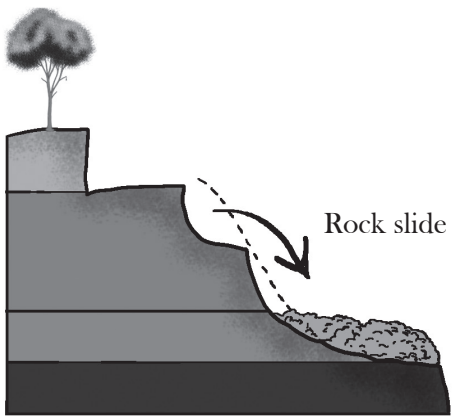
Debril fall



Debril slide



Rock fall



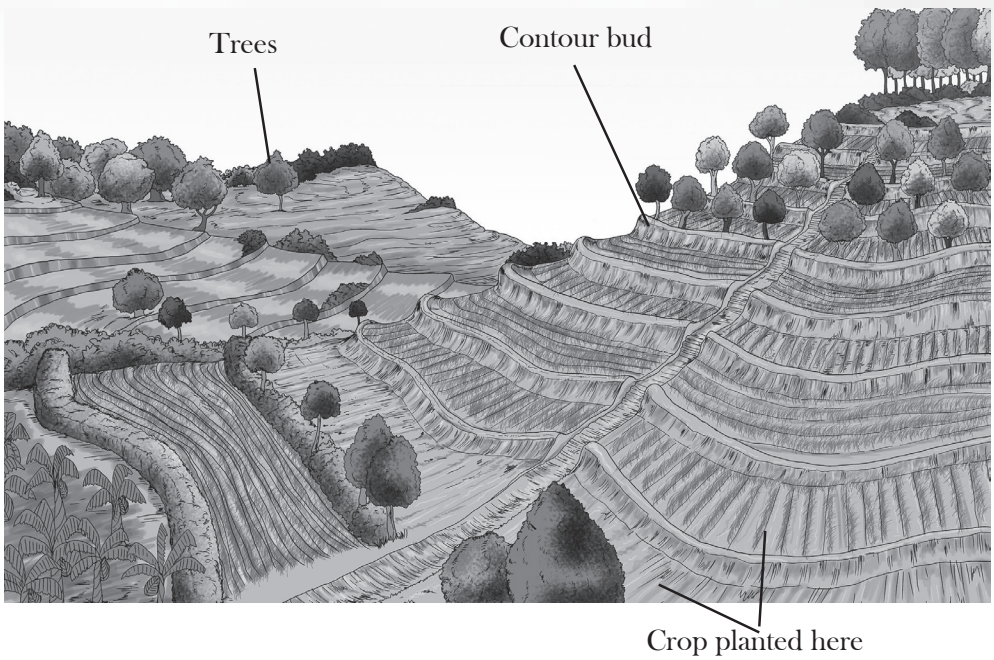
Effects of mass wasting

(a) Loss of fertile soil.
(b) Damages properties and farmland.
(c) Causes loss of life.
(d) Causes permanent scars on the landscape.
(e) May create artificial lakes.

1.10 Suggested Answers to End of Unit 1 Assessment (page 69 of Student's Book)

1. Sheet is the uniform removal of the top layer of soil while rill erosion is the removal of soil from small but well defined channels.
2. Overgrazing destroys the vegetative cover on the soil which exposes it to wind and water erosion.

3.



A diagram of contour farming

4. (a) Gently sloping land
   (b) Steep areas at the head of the farm to protect the lower farm land where storm water needs to be directed away from structures, roads or buildings.
   (c) Where gully erosion has occurred.
5. (a) Ridges and furrows
   (b) A– ridge B – furrow
   (c) (i) Hold surface run-off allowing water to infiltrate through the soil.
   (ii) Leads surface run-off into a water way.
6. (i) A – Frame
   (ii) (a) After placing the two legs on an A – frame on the same level ground, mark the spot where one of the legs is standing with a peg or stone.
   (b) Then lift that leg, while the other leg remains in place and rotate an A – frame (in a semi-circle) until the lifted leg is on the opposite side. Now place it on the ground and adjust it until the weighted string touches the mid-point mark of the cross bar.
   (c) Place a peg where the second leg of an A – frame has been standing.
   (d) Lift the second leg and rotate it until it is on the opposite side of the frame.
   (e) Repeat this process marking the ground where each leg stands before moving it to the opposite side.
   (f) When this points are marked across the slope, the line that joins the

pegs together on the ground is the contour line.

(g) Ridges, terraces or crops can be planted along the contour line.

7.

Type of soil erosion	Agent of soil erosion
Splash	Human activities
Sheet	Raindrops
Rill	Moving water
Gully	Wind
Saltation	

8. Reduces the speed of run-off thus increasing water retention and infiltration.

1.11 Remedial activities for slow learners

1. What is a grass strip?
   This is where a crop is planted in alternate strips with grass.
2. How does the grass strip control soil erosion?
   (i) It reduces the speed of run off thereby depositing soil which had been eroded from the crop strip.
   (ii) It holds run-off water therefore increases infiltration.
   (iii) It provides the soil with a cover prevented wind erosion.
   (iv) Grass root hold soil from being eroded.
   (v) Grass leaves and roots decompose to increase organic matter which increases infiltration.
3. Mention three mechanical constructions used to control soil erosion.
   (i) Terraces
   (ii) Bunds
   (iii) Stone lines
   (iv) Trash lines
   (v) Anti-erosive ditches
   (vi) Gabions/porous dams
   (vii) Diversion channels
4. How does raindrop initiate soil erosion?
   (i) Heavy raindrops hitting bare soil detaches soil particles.
   (ii) The detached soil particles are dispersed in different directions leading to uniform removal of soil.
   (iii) A hole is hollowed out where the soil was detached.
   (iv) Several holes hollowed out join to form rills which then join to form channels.
   (v) These channels join, deepen and widen to form gullies.

1.12 Extension activities for gifted and talented learners

1. Describe how gully erosion occurs.

Answer:

(i) Gully formation starts with the movement of water as run-off from a water shed that has no vegetation.

(ii) A uniform layer of soil is carried away by run-off from the surface.

(iii) Water concentrates in the weaker areas of the soil to form rills and then small channels.

(iv) The channels start wearing at the sides and widen to form V-shaped gullies.

(v) Scouring of the floor of the channels by the eroded soil and rock as they move down in the force of the water.

(vi) This widens the gullies both at the base and at the top to form U-shaped mature gully.

2. Outline four effects of soil erosion on agricultural land.

(i) Carries away fertile soil leaving land unproductive.

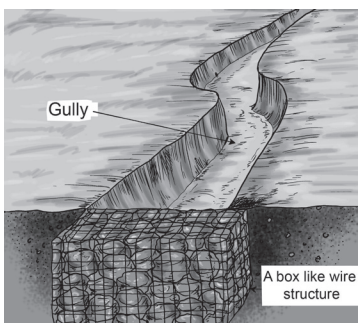
(ii) Exposes roots of growing crops/plants.

(iii) Uproots plants/crops.

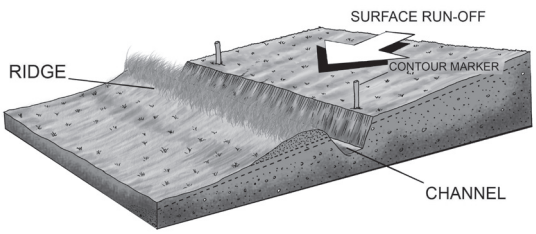
(iv) Leads to formation of ugly land marks like rills and gullies.

(v) Deposited soil covers crops.

3. Study the sketches of mechanical soil conservation measures given below and then answer the questions that follow:



A



B

Figures A and B

(a) Identify the mechanical constructions A and B

Answer:

(i) A – Gabion or porous dam

(ii) B – Stone line

(b) Indicate using arrows the direction of the slope in each illustration.

(c) Find out the most appropriate type of erosion which would be controlled by each of the constructions.

Answer:

(i) A– Gabions or porous dams are constructed where gully erosion has

taken place or where constructors cut deep into the soil to leave a bare wall of soil.

(ii) B – Stone line are constructed in gently sloping piece of land to control run-off and protect the land below it.

1.13 Structure of every lesson

Lesson 1: Types of soil erosion

Learning objectives

(a) Knowledge and understanding
  (i) Define soil erosion.
  (ii) State the types of soil erosion.

(b) Skills
  (i) Recognise the meaning of soil erosion.
  (ii) Compare the types of soil erosion.

(c) Attitudes and values
  (i) Show concern to soil erosion.
  (ii) Agree on the types of soil erosion with group members.

Prerequisites/Revision/Introduction

Teacher introduces the lesson by asking questions relating to what learners study in soil to find the prerequisite that learners have on soil.

- What is the meaning of soil?
- Soil was created by God. Do you think it doesn't change? Suggest the ways it may change.

(a) Teacher uses video of soil and asks directive questions to learners to help them to discover the lesson.

or

(b) Teacher uses pictures of gully erosion and splash erosion and asks learners directive questions to discover the lesson (Page 2 of Student's Book).

Teaching Aids

- Eroded land/pictures of eroded land.
- Hills (sloped land).
- Pens.
- Notebook.
- Library books
- Text books
- Internet
- Video tapes

For learners with special needs (visual impairment) they can use their hands or feet to

identify eroded soil.

Learning activities

(a) Research and discussion.
(b) Field trip.
(c) All answers of questions about lesson one if any are in page 4-6 in the Student's book.

Synthesis

Learners are asked to discuss and come up with a summary of assignment given on types of soil erosion. Teacher consolidates the learners findings (page 3 - 6 of Student's Book).

Assessment

1. Differentiate between sheet and rill erosion.

Answer

Sheet erosion is the uniform removal of the top layer of soil while rill erosion is the removal of soil from small but well- defined channels.

2. What is a soil erosion?

Answer: Soil erosion is the gradual of the soil particles and their movement from one place to another.

Lesson 2: Causes of soil erosion

Learning objectives

(a) Knowledge and understanding:
    (i) differentiate the causes of soil erosion.
(b) Skills
    (i) Examine the causes of soil erosion
(c) Attitude and values.
    (i) Participate actively in group discussion

Prerequisites/Revision/Introduction

Teacher asks the following questions to review the previous lesson:

- Identify one type of soil erosion found in a visited eroded area/land.

Teaching Aids

- Eroded lands

- Overgrazed land
- Base land
- Notebook
- Pens
- Questionnaires.

Learning activities

Field visit

The teacher to organise for a field visit, prepare questionnaire as shown in annex 2 and then conduct the visit. Learners to make observations on causes of soil erosion that they can see, discuss and present to the class. Teacher to conclude and give summary notes.

Synthesis

Using an assignment, learners summarise content on causes and agents of soil erosion. The teacher consolidates the summary of the lesson (page 7 of Student's Book).

Assessment

1. Explain how overgrazing increases soil erosion.

Answer

Overgrazing destroys vegetative cover on the soil which exposes it to wind and water erosion.

2. What is wind abrasion?

Answer

A process of erosion produced by the suspended particles that impact on soil objects. Wind-blown particles that move at high speed wears away rocks by abrasion.

Lesson 3: Effects of soil erosion

Learning objectives

(a) Knowledge and understanding.
    (i) Determine the effect of soil erosion.
(b) Skill
    (i) Point out the soil affected by erosion.
(c) Attitude and values.
    (i) Notice on the effects of soil erosion.

Prerequisites/Revision/Introduction

Teachers asks learners the following question to review the previous lesson:

- Examine the eroded area/land and find out its causes.

Teaching Aids

(a) Eroded land.
(b) Internet.
(c) For Special Education Needs, especially those hard of hearing; use of loud speaker connected to the computer.
(d) Use books and library for schools with limited resources.

Learning activities

Research and discussion

The teacher introduces the unit on effects of soil erosion, instructs the learners, give their opinion. Learners find out the effects of soil erosion, from the references provided, discuss and present their findings to the class. Teacher then gives summary notes.

Synthesis

Teacher consolidates the findings of learners after their presentations (page 18 - 19 of Student's Book).

Assessment

Explain the effects of soil erosion.

Answers

(i) Leads to loss of soil nutrients – This is by carrying away fertile soil.
(ii) Reduce the depth of soil– Removal of the top soil exposes the infertile soil and bed rock.
(iii) Exposes plant roots – Carries away soil from around the plant roots.
(iv) Uprooting of crops – Water moving with the soil wears away the fibrous roots reducing their ability to anchor the plant.
(v) Production of gullies – Ugly land marks are left making it difficult to work on the land.
(vi) Fill dams and other water reservoirs – This reduces the amount of water due to silting.
(vii) Kills acquatic animals – Silting leads to suffocation of water life.

Lesson 4: Factors causing soil exhaustion

Learning objectives

(a) Knowledge and understanding
    (i) State the factors affecting soil exhaustion.
(b) Skills
    (i) Recognise the factors affecting soil exhaustion.
(c) Attitude and values
    (i) Listen carefully to the colleagues.

Prerequisites/Revision/Introduction

Teacher asks the following question which test what learners should know before the development of new lesson:

- Does soil erosion have effects?
- If yes, in which ways?

Teaching Aids

- Text books
- Pens
- Questionnaires

Learning activities

Research and discussion

Teacher instructs learners to give their opinion on the factors causing soil exhaustion after getting information from references given. Learners to discuss and present their findings to class and take summary notes from the teacher.

Answers to activity on table 1.1 pages 21 - 22 of Students' Book 3

	Identity of the practice	**Damage on soil**
(a)	Deforestation/cutting down of trees	(i) Expose the soil to agents of soil erosion such as moving water and wind. (ii) Reduce organic matter supply to the soil leading to poor structure.
(b)	Overgrazing	(i) Remove the protective cover on the soil increasing soil erosion. (ii) Soil is baked hard by the sun leading to poor structure.
(c)	Cultivating on bare steep slope	(i) Exposes the soil to raindrop erosion. (ii) Increases the speed of water run-off hence more erosion.
(d)	Burning of vegetation	(i) Kills soil organisms. (ii) Removes organic matter leading to loss of humus. (iii) Loss of soil moisture. (iv) Loss of some volatile nutrients.

Synthesis

Teachers consolidates the presented findings by learners as a summary of lesson (page 19 - 21 of the Student's Book).

Assessment

Explain the factors that cause soil exhaustion.

Answer

(i) Overcropping – growing crops on a pice of land continuously remove large quantities of nutrients from the soil.

(ii) Leaching – When soluble nutrients move from top soil to the lower horizons of the soil, they leave the top soil infertile.

(iii) Overgrazing – Continuous removal of soil nutrients by grasses and legumes eaten by animals leave the soil without nutrients.

(iv) Burning of plants – Destruction of organic matter prevents nutrients recycle back onto the soils.

Lesson 5: Prevention methods of soil erosion control

Learning objectives

(a) Knowledge and understanding.
   (i) Describe environment conservation measures.

(b) Skills
   (i) Perceive various measures of environment protection conservation.

(c) Attitude and values.
   (i) Appreciate the importance of environmental conservation.

Prerequisites/Revision/Introduction

Through questions, the teacher asks learners the methods of preventing soil exhaustion to review the previous lesson.

Teaching Aids

- Land covered with legume crops.
- Terraced land if applicable.
- Land protected by trees.
- Land mulched with dry grasses.
- Pens.
- Notebooks.
- Video
- Learners with visual impairment touch the land using hands and feet.
- Internet

Learning activities

Field trip

The teacher to guide learners to observe and identify prevention methods of soil erosion.

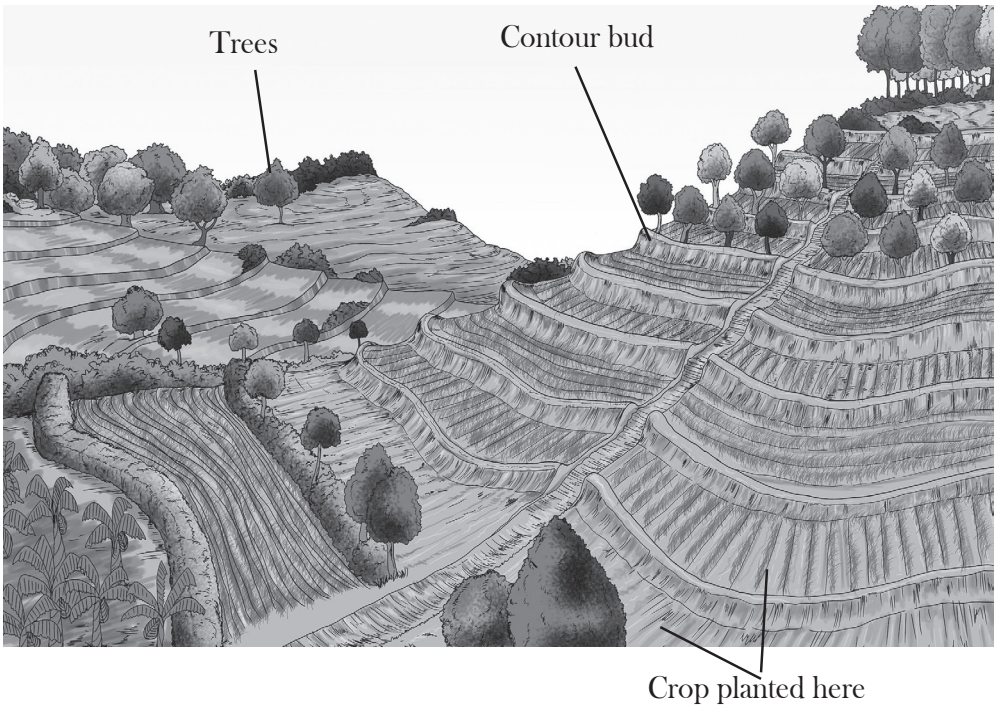
Synthesis

Teacher consolidates the findings presented by learners on prevention method of soil erosion observed on the terrain (pages 25 - 26 of Student's Book).

Assessment

1. Draw a well-labelled diagram showing contour farming.

Answer



A diagram of contour farming

2. Explain how cover cropping and mulching help to control soil erosion.

Answers

(i) **Cover-cropping:** Prevents surface flow/reduces impact of rain drops/prevent evaporation/volatisation/improves soil structure.

(ii) **Mulching:** Reduces impact of rain drops/prevents evaporation/surface run-off.

Lesson 6: Various measures for soil conservation

Learning objectives

(a) Knowledge and understanding.
   (i) Carry out environment conservation measures.

(b) Skills
   (i) Practice various measures of environment protection and conservation.

(c) Attitude and values.
   (i) Show awareness and interest about the protected environment.

Prerequisites/Revision/Introduction

Through oral questions, the teacher asks learners to review the previous lesson on prevention methods of soil erosion control by answering the following question:

- Describe the way the identified environment conservation measures on the terrain were controlling soil erosion.

Teaching Aids

- Hills
- Transparent water hose level
- A – frame
- Pegs
- Tape measure
- Pens
- Notebooks
- Questionnaire

Special Education Needs/physical impairment) will be assisted with normal learners.

Learning activities

Field trip

- **Mechanical/physical measures:** The teacher to prepare questionnaire as shown in annex 3 and organise for a field trip. Learners to make observations, discuss and present them to class and then summary notes.
- **Measuring contour lines using an A frame and a transparent water hose level:** The teacher to prepare a questionnaire as shown in Annex 4 and conduct a field visit to measure contours using an A-frame and a transparent water hose level. The learners to measure the contours, discuss their findings and present them to the class. Teacher to give summary notes after learner's presentation.

Synthesis

The teacher to consolidate the presented findings by learners on cultural measures of erosion control as a summary of lesson (pages 27 - 32 of Student's Book).

Assessment

1. Why is it recommended to carry out farming activities along the contours?

Answer

It reduces the speed of run-off thus increasing water retention and infiltration.

2. Explain how windbreaks can contribute to soil conservation.

Answer

Windbreak protects both the windward side (the side where the wind is blowing from) and the leeward side (the side where the wind is blowing to). Windbreak trees should be planted in long and continuous rows without gaps.

Lesson 7: Various measures for soil conservation (physical and mechanical/ structural methods)

Learning objectives

(a) Knowledge and understanding.
   (i) Carry out environmental conservation measures.

(b) Skills
   (i) Practice various measures of environment protection and conservation.

(c) Attitude and values
   (i) Show awareness and interest about the protected environment.

Prerequisites/Revision/Introduction

Teacher conducts learners to the field and reviews the previous lesson on cultural methods of soil conservation by asking questions like:

- What is the purpose of measuring contour lines and how contour lines may conserve the soil?

Teaching Aids

- Hills
- Transparent water base level.
- Pegs
- Tape measure
- Mattock
- Hand hoe
- Spade or shovel.
- Grass seedlings, cuttings or seeds.
- Machete
- Pick axe
- Questionnaire
- Trash materials
- Wire mesh
- Planting lines
- For an A- frame.
  - Two straight 5 × 2.5 cm pieces of timber or wood each 2 m.
  - One straight 5 cm × 2.5 cm piece of wood, 1m long (cross bar).
  - Four 5 cm screws .
  - One piece of 2.5 m long string.
  - A weight or a stone.
  - One small spirit level.
  - A twist drill and a bit the size of the screws.
- For the transparent water hose level.
  - A clear plastic water hose pipe approximately 15 m long and 1.25 cm diameter.

- Two flat-topped wooden staves, 1m high.
- A string or wire (to bind the pipe to the stave).
- A tape measure.
- A pair of wire cutting pliers.

Learners with Special Education Needs especially, the physically challenged will be assisted by normal learners.

Learning activities

Field trip: Practical activity.

The teacher to prepare a questionnaire as shown in Annex 5. Prepare for a field visit and instructs the learners to construct the terraces, ridges, bunds and diversion channels in groups. Learners discuss their findings and present to the class. The teacher to give summary notes.

The teacher to prepare a questionnaire as shown in Annex 6 and conduct a field visit. Learners to construct erosion control ditches and stone lines in groups, discuss and present their findings to the class and then take the teacher's summary notes.

Answer to exercise 1.3

(a) (i) Excavating the soil and the refilling it downwards to form the bench and upwards to form the riser.

(ii) A complete bench terrace showing the riser (A) and the Bench (B).

Answers to exercise 1.4 (page 50 of Student's Book).

(i) (a) Tie ridges

(b) Contour bunds

(c) Trapezoid – type diversion channel

Differences between structures: (a) Tie ridges and (b) Contour bunds.

Tie ridges	**Contour bunds**
Have small ridges called cross ties that block the farrows. Cross ties trap water and allow it to seep into the soil. Cross ties prevent water from breaking the ridge. Used in gently sloping areas with low rainfall.	Have open farrows. Water flows through the open furrows without seeping into the soil. The band can easily be broken and washed away by water. Used in steep areas with high rainfall.

Synthesis

Through demonstration, teacher consolidates the practical activities of learners on construction of terraces, ridges, diversion channels, anti-erosion ditches, gabions and trash lines (pages 33 - 66 of Student's Book).

Assessment

Explain the procedure of establishing the grass filter strip and store lines.

Answer

Procedure 1: Grass filter strip

(a) Determine where the filter strips are required, their width and the number required. This depends on the area to be covered.
(b) Prepare the strips into weed-free seedbed.
(c) Plant suitable grass such as sugarcane, *cetaria, sphacelotheca, paspalum notatum* but avoid creeping grasses such as star grass, deep rooted legumes can also be used.
(d) Planting should be done during the rains when the other crops are being planted to avoid drying of the grass strips procedure.

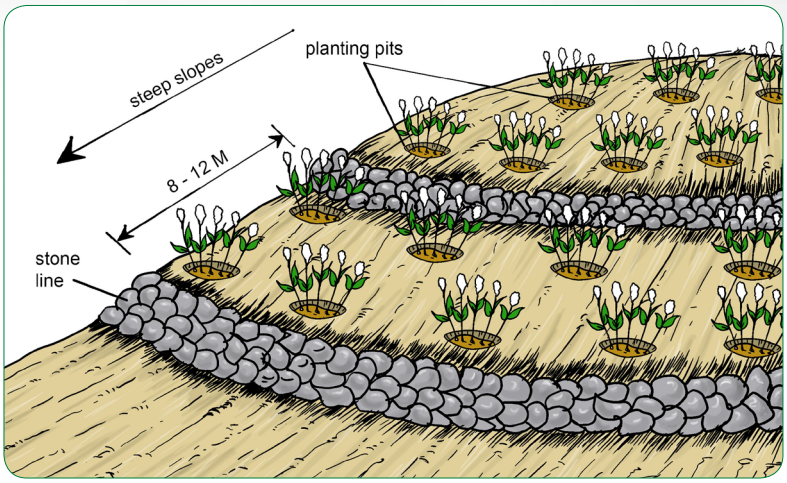
Procedure 2: Stone lines

1. Collect many different sized stones.
2. Pile the stones on the contour lines marked with an A-frame.
3. Pile a line of 0.4 m – 0.6 m wide and 0.5 m high; put them close together to prevent any gaps in between.
4. Plant some shrubs on either side of the stone line in pits. Stone line have very little maintenance practices except to return the fallen off stones in the line.

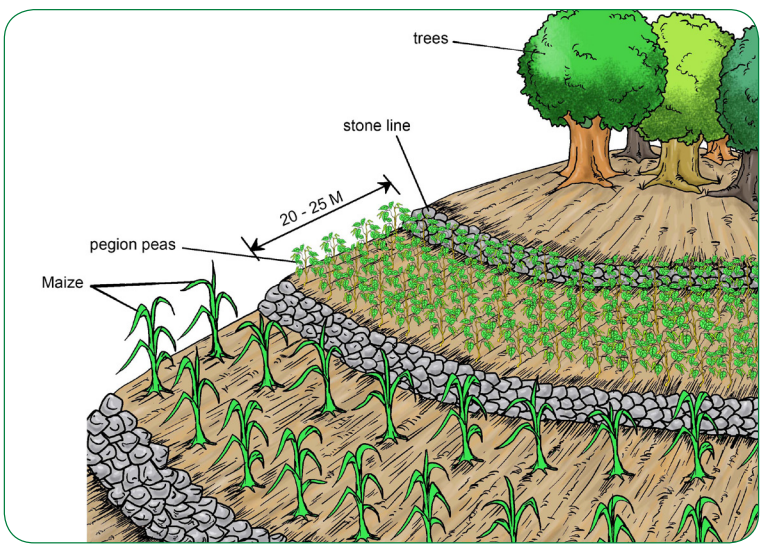
Stone lines

These are long rows of stones piled together to form barriers across the field. Stone lines are commonly used in the dry and humid areas of Africa to control soil erosion. They are used in places where there are loose stones in the fields. Stone lines are made by heaping stones about 0.4 m –0.6 m wide and 0.5 m along the slope to trap soil carried by run-off water. They slow down the run-off and soil gradually builds up behind these lines of stones. They are used on both flat and sloppy lands.

The distance between the lines depends on the slope and the amount of stones available. It should be about 20 m – 25 m apart on a gently sloping areas and 8 m – 12 m in steep areas. If the stones collected from the farm are not enough, they can be ferried using donkey carts or lorries from other places such as quarries. Stone lines follow the contour lines which should be determined using an A-frame or the transparent water pipe level. Grass or trees are planted on either sides of the stone lines in order to give an effective conservation farming. Planting pits are often used with stone lines as shown in figure 1.57 (a) and (b).



(a) Stone lines in combination with planting pits



(b) Stone lines on a gently sloping area

Unit 2 Cereals

2.0 Key Unit Competence

Learners should be able to conduct cultivation of cereals.

2.1 Prerequisite knowledge and skills

Learners should have knowledge and practical skills in crop production such as land preparation, planting, fertiliser application, weeding, field maintenance practices and harvesting.

2.2 Cross-cutting issues to be integrated in the teaching and learning activities

When teaching this unit, the following should be addressed:

(i) **Gender:** The unit is relevant to even the cultural ways of producing crops. Every one both girls and boys, should appreciate and engage in the learning of production of cereals which brings equity and increased production.

(ii) **Peace and values education:** Working together by respecting each other and efficient use of tools like hand hoe and slasher, that may injure colleagues during practice helps to avoid conflict and accidents.

(iii) **Standardisation culture:** It is important to adopt a standardisation culture while selecting the best fertiliser and applying the exact quantity for rice, maize and wheat.

2.3 Generic competences:

- **Critical thinking and problem solving skills** – Learners will think broadly to analyse and find solutions to problems of farmers who still use hand hoe in large area in cultivation of cereals.
- **Research** – This will help learners to find answers to questions based on existing information while researching on internet or reading books in school library.
- **Co-operation, inter personal management and life skills** – This will help the learners to co-operate as a team in whatever task assigned to practise positive ethical moral values while respecting rights, feelings and views of others.

2.4 Key terms

1. **Cereals:** These are grain crops commonly produced to provide carbohydrates and used as staple food in some regions.
2. **Caryopsis:** Is a fruit of a grain crop which resembles a seed. It contains an endosperm and embryo enclosed in a pericarp.
3. **Endosperm:** Part of a grain which stores food for the developing embryo during germination.
4. **Germ:** Part of a grain that develops to a plant (also the embryo).
5. **Bran:** Hard outer layers of a cereal grain consisting of the pericarp.
6. **Herbacious:** Succulent plant with no persistent woody stem above the ground.
7. **Narrow leaved :** Grass type of leaf with narrow leaf blade and parallel veins.
8. **Hidden buds:** A bud which is covered or enclosed with other leaves usually seen in grasses.
9. **Inflorescence:** A group or a cluster of flowers arranged on a stem.
10. **Fibrous roots:** Thin and highly branished root system originating from the stem usually seen in grasses.
11. **Mouldboard plough:** A plough with a part fixed at its end called a mouldboard that inverts cut furrow slices during ploughing.
12. **Rotary cultivator:** A ploughing implement which combines the practices of primary and secondary cultivation using power from engines.
13. **Bund:** A raised soil embarkment with plants grown on them .
14. **Fungicide:** A chemical used to kill fungal organisms and diseases.
15. **Soil fumigation:** Application of chemicals in the soil to kill or sterilise the soil by suffocating the organisms.
16. **Ridger:** An implement which is used to open furrows.
17. **Thinning:** Removing excess seedlings from a planting hole or bed by uprooting.
18. **Gapping:** Replanting seeds where they failed to germinate or were destroyed by pests.
19. **Prussic acid:** An organic substance that is metabolised by animals to form cyanide which is poisonous.
20. **Silage:** Fodder converted into succulent feed for livestock through

processes of anaerobic bacteria fermentation.

21. **Rice mill:** A machine which is used to separate bran from the seeds by polishing them.
22. **Fodder:** Plants that are harvested and chopped for use by livestock.
23. **Bread:** Staple food prepared from dough of flour from cereal grains mixed with water and yeast then baked.
24. **Staple:** Basic food.
25. **Fibre:** A substance that contains a large amount of cellulose and lignin that is not easily digestible.
26. **Surplus:** Excess.
27. **Green manure:** Manure made from incorporating green leafy plant materials into the soil through cultivation.
28. **Mulch:** Materials which are placed over the soil surface and between crops to smoothen weeds and conserve soil moisture.
29. **Herbicide:** A chemical which kills plants.
30. **De-stumping:** Removal of stumps from a field after felling trees.
31. **Sub-soiling:** A method of cultivation where ploughs dig deep to bring up soil from lower levels to upper levels.
32. **Combined harvester:** A machine which combines the practice of harvesting and threshing mature cereal crops.

2.5 Problem statement: Guidance to the teacher

(a) Guide the learners to analyse the photographs given in Student's Book page 72 in groups.

(b) Assist the learners to identify photographs:
Farmers who prepare the land/cultivate the soil with hand hoe.

(c) Guide learners on how to help the farmers to solve the problem of preparing their filed at time:
   (i) Renting of tractors and / or tillers.
   (ii) Forming farming cooperatives which can help them to easily rent tractors/tillers.

(d) Guide the learners on how to help the farmers in Bugesera District to improve

yields as follows:

(i) Quick preparation of lands:

(ii) Planting early at the beginning of rains.

(iii) Other activities such as weeding, fertiliser application, pests and disease control and harvesting among others are done.

(iv) Timely harvesting to prevent losses of the mature crop in the field.

(e) Allow the groups to present their findings to the class.

2.6 Suggestions for accommodating Special Education Needs (SEN)

Type of impairment	Support for the learners
Sensory Impairment (visual)	• Use large print instruction sheets, questionnaires and assessment papers. • Allow students to sit near the chalkboard. • Use large legible letters. • Pair the learners with students with good vision to assist them in practicals.
Sensory Impairment (hearing)	• Be audible. • Allow them to sit close to teacher.
Physical impairment (motor)	• Pair them with able bodied learners to assist them to carry tools and equipment. • Carry out practicals in one place to avoid much movement.
Gifted or talented learners	• Assign extra duties such as report writing. • Ask them to assist slow learners. • Distribute them to different working groups.

Slow learners	• Take time when going through procedures. • Repeat the tasks to encourage internalisation. • Assist when a task is given. • Arrange for extra teaching.

2.7 List of lessons

Lesson no	No. of periods	Weeks	Lesson title
1	1	1st week	Botanical characteristics of cereals Some cereals cultivated in Rwanda
2	1	1st week	Importance of cereals (nutritional value and agricultural importance).
3	3	2nd week 3rd week	Traditional practices of cereals
4	1	3rd week (1 period)	Traditional practices of cereals
5	2	4th week	Traditional practices of cereals with assessment

2.8 Unit Summary

Cereals are grain crops which belong to the grass family graminae. The seed is also a fruit known as kernel or a caryopsis. Cereals provide man with carbohydrates and are widely produced and consumed as staple crops. Cereal plants have herbaceous stems, narrow and parallel veined leaves hidden buds with flowers on inflorescence and fibrous roots.

Cereal crops cultivated in Rwanda include rice, maize, sorghum and wheat. Rice is

mainly produced under irrigation in the swampy lowlands. Wheat is produced in the cooler highlands while maize is produced in the medium altitude areas.

Cereals are mainly grown for food, bedding for livestock, income, source of employment, source of government revenue, provision of grains for socio-cultural practices, preparation of manure and mulch. Cereal production practices include land preparation, planting, weeding, gapping, thinning, pest and disease control and harvesting.

Additional information for the teacher

Other cereals grown in Rwanda

These include millet and barley.

Millet is a traditional cereal. There are two forms of millet grown in Rwanda:

(a) Finger millet

(b) Bulrush millet

Finger millet is more commonly produced in Rwanda.

Millet is used to make traditional meals, brews and is presented in socio-cultural ceremonies.

(a) Finger millet

(b) Bulrush millet

Barley

This is another cereal which was introduced in Rwanda in the 20th Century. Currently, Barley is grown by contracted farmers to supply the brewery industries.

Barley plant

Post-harvest practices of cereals

Post-harvest practices are important because majority of the products obtained by farmers get spoilt before it can reach the consumers.

To protect the grains from insect pests, fungal attack and hot and cold diseases, the following activities are carried out after harvesting:

1. Drying
2. Winnowing
3. Sorting
4. Dusting
5. Packaging

Drying

This is the process of reducing moisture content in grains to a level of 13%. It is done through sun-drying, where the grains, heads, panicles or cobs are spread over a tarpaulin during a hot sunny day to reduce the moisture content in the grains.

Drying of harvested sorghum

Drying helps to prevent:

(a) Growing of moulds some of which produce poisonous substance such as aflatoxins.

(b) Sprouting– Some cereal grains sprout if the moisture condition is high in poor storage conditions.

(c) Breakage and bruising– Poor dried grains are prone to breakage and bruising if not properly dried, reducing the quality of the produce.

(d) Attack by insect pest

Poorly dried grains are more prone to attack by storage insect pests such as weevils, grain borers and grain moths.

Winnowing

This is the process of separating the grain from particles known as chaff. Chaff contains remains of husk or the particles and leads to the following problems:

(a) Harbouring pests and moulds.
(b) Retaining moisture preventing drying of grains.
(c) Spoilage of quality and taste.

Chaff is removed from grain through winnowing. Mechanical winnowing is done using wind energy, where seeds are scooped and poured over a height. Since chaff is lighter than grain, it gets separated:

Winnowing

Sorting and grading

Sorting is the process of separating different grades of grain either by passing them through a series of meshes or by centrifugal force where machines known as shakers separate small grains from large grains.

Sorting is commonly practised when selecting seeds for planting. Larger seeds are selected because they have a better germination percentage.

Grading is the process of assigning quality to different strains of grain. Grading help to improve marketability of the grain. Whole grains, large grains with uniform colour fetch a better market price.

Dusting

This is the process of applying insecticides to stored grains to control insect storage pests. Insect pests account for at least a half of the yield lost in the production of cereals. Common insecticides used during dusting include malathion and pyrethrins.

Packing

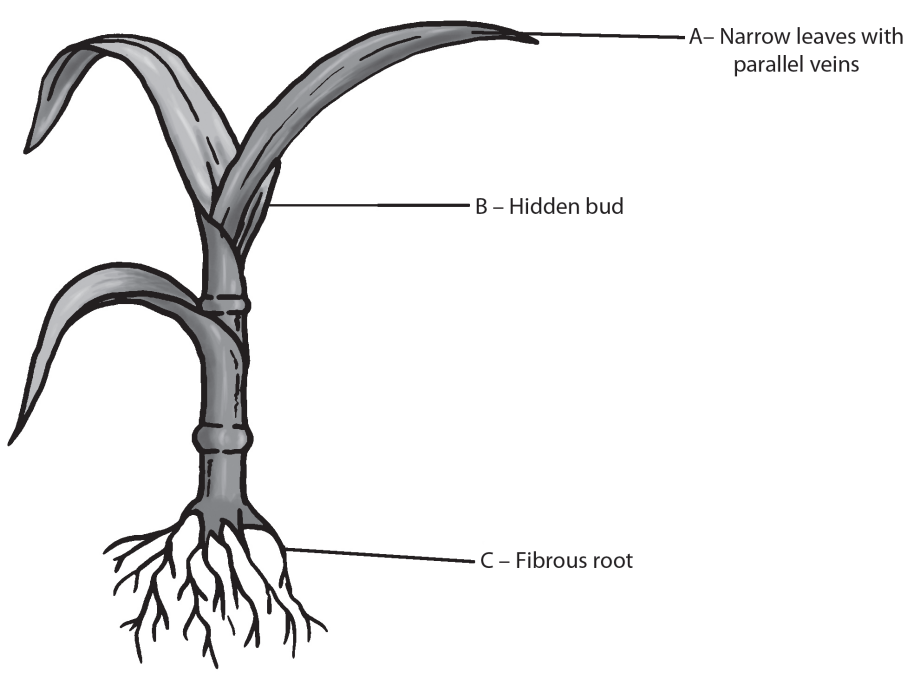
This is the process of measuring and keeping dried and dusted grains in bags or containers. Packing is important to ensure:

(i) Ease of transportation.
(ii) Prevention of losses through spillage.
(iii) Measurement to fix market prices.
(iv) Prevention of contamination.
(v) Prevention of pest and mould attack.

Packaging is done in sisal bags, jute bags and gunny bags. Plastic bags are discouraged because they do not allow the grains to dry properly.

2.9 Suggested answers to end of unit 2 assessment (students' book page 118)

1.



2. (i) Prepare land during the dry season by slashing weeds and previous crop residue, ploughing deeply.
   (ii) Harrowing to produce medium tilth.
   (iii) Dig holes at a spacing of 75–90 cm by 23–30 cm.
3. (i) Apply 150–200 kg of Triple Super Phosphate (T.S.P.) or Double Super Phosphate (D.S.P.) per hectare at planting.
   (ii) Apply nitrogen and magnesium foliar feed when the plants are 30–45 cm high and when they are 75–90 cm high.
4. (i) Flood the field to 10 cm after ploughing.
   (ii) Drain the field to 5 cm before puddling.
   (iii) Drain the field to 1.5 cm level before broadcasting seed.
   (iv) Maintain level of water at 1/3 the height of the plant.
   (v) Allow water to flow slowly into the paddy fields.
   (vi) Change water every 2–3 weeks.
   (vii) Drain the field 2–3 weeks to allow the field to dry before harvesting.
5. (i) Use resistant varieties.
   (ii) Control of insect vectors.
6. (i) To reduce competition.
   (ii) To reduce spread of pests and diseases.
7. Maize streak virus

8. (a) Open panicle
   (b) Compact panicle
   (c) Goose Neck variety

2.10 Remedial activities for slow learners

1. Name three other importance of cereals apart from nutrition and agricultural.
   (i) Sold as surplus to give income.
   (ii) Used in socio-cultural ceremonies.

2. Give the spacing when transplanting.
   (a) Rice 10 cm x 10 cm
   (b) Wheat 30 cm between the rows
3. Name the fertilisers used during production of rice and their functions.
   (i) Sulphate of Ammonia – supplies nitrogen and sulphates
   (ii) Diammonium phosphate – supplies nitrogen and phosphorous
   (iii) Double supper phosphate – supplies phosphate
4. State the importance of the following in cereal production:
   (a) Weeding
      (i) To reduce competition for nutrients.
      (ii) To conserve moisture.
      (iii) To minimise spread of pest and diseases.
      (iv) To economise the use of chemicals when controlling pests and diseases.
5. State the most appropriate method of controlling the following pests without the use of chemicals:
   (a) Army worms in a field of rice
      – Flooding.
   (b) Birds in a field of sorghum
      – Use of a scare crow.

2.11 Extension activities for gifted and talented learners

Describe the practices carried out during the production of rice under the following sub-heading:

1. Nursery preparation and establishment

- *A single nursery bed should measure 18.5 m x 18.5 m.*
- *The land is cleared and trash removed.*
- *Bunds are constructed by heaping soil to a height of 30–45 cm above the bed to hold water.*
- *Construct an inlet and outlet channels.*
- *A rotavator is used to prepare the land or digging deeply using a hand hoe.*
- *The field is flooded to 10 cm.*
- *The nursery is paddled to form a smooth paste.*
- *Levelling is done by dragging a levelling board through the bed.*
- *Seeds are pre-germinated by soaking in water for 24 –36 hours.*
- *Water in the nursery bed is drained to leave 1.5 cm above the level of soil.*
- *25 kg of sulphate of ammonia is applied per each nursery bed of (18.5 m × 18.5 m).*
- *Broadcast pre-germinated seeds at a rate of 20 kg per nursery bed.*
- *Increase the water level gradually from 1.5 cm to 5 cm as the seedling grows maintaining water levels at 1/3 the height of the seedling.*

2. Difference between the cultural practices when sowing maize and sowing rice.

Maize	**Rice**
(i) Done on a dry field *(ii) The tilth is medium*	– *Done on a wet field* – *The tilth is smooth*
(iii) Slanting is done in rows and hole measuring *(iv) Phosphatic fertilisers are applied to the furrow or hole before planting*	– *Planting is done by broadcasting seeds* – *Nitrogenous fertilisers are broadcasted before planting*

3. Explain the problems associated by not drying grains properly before storage.
   (i) Growing of moulds, these originate from spores of fungi and thrive well in improperly dried grains.
   (ii) Sprouting:
   A high moisture content in seeds provides an avenue for the process of germination to start to take place by activating the embryo, enzymes and hormones.
   (iii) Breakage and bruising:
   Improperly dried grains have soft taste which makes them bruise and break easily. This spoils the market quality.
   (iv) Attack by insect pests:
   Storage insects can easily penetrate undried testa or seed coat. This leads to high losses.

2.12 Structure of every lesson

Lesson 1: Botanical characteristics of cereal and some cereals cultivated in Rwanda.

Learning objectives

(a) Knowledge and understanding.
   (i) State the characteristics of cereals
   (ii) Give example of cereals grown in Rwanda.

(b) Skills.
   (i) Detect the characteristics of cereals
   (ii) Select the common cereals cultivation in Rwanda.

(c) Attitude and values.
   (i) Agree to the characteristics of cereals
   (ii) Be aware of cereals cultivation in Rwanda.

Prerequisites /Revision/Introduction

Teacher introduces the lesson by asking learners the following questions on crops:

- List only 10 crops/plants you know.
- Group them according to their resemblances.

Teaching Aids

- Cereal field where application.
- Pictures of cereal crops if possible, rice, maize, sorghum and wheat.
- Pens
- Questionnaires
- Internet
- Computer
- Library Books
- Magazines

Learning activities

Field visit and discovery

The teacher provides a questionnaire as shown in Annex 8 and organises for a field visit to a farm growing cereals to observe the botanical characteristics. The learners then make observations and using the questionnaire, outline the botanical characteristics of a young and mature cereal plant, discuss and present their findings to the class. Then take teacher's notes. The teacher divides the learners into groups, provides materials and instructs the learners to find out the cereals cultivated in Rwanda.

The learners to discuss, record their findings and report their findings. Then take summary notes from the teacher.

Answers

Exercise 2.1 page 74 of Student's Book

A – Leaves
B – Tiller
C – Stem
D – Fibrous roots

Exercise 2.2 page 76 of Student's Book

E – Rice
F – Maize
G – Sorghum
H – Wheat

Synthesis

The teacher consolidates the findings presented by learners as a summary of lesson (page 73 – 78 of student's book).

Assessment

Identify characteristics of cereals and name the types of cereals cultivated in Rwanda.

Answer:

Observable characteristics of cereals:

- Herbaceous.
- Narrow leaved.
- Buds and flowers on inflorescence.
- It has fibrous roots.

Lesson 2: Importance of cereals

Learning objectives

(a) Knowledge and understanding.

(i) Discuss the importance of cereals.

(b) Skills.

(i) Recognise the importance of cereal.

(c) Attitudes and values.

(i) Appreciate the importance of cereals, show team spirit in research and group discussions.

Prerequisites/Revision/Introduction

Through questions, the teacher asks learners to detect the characteristics of cereals to review the lesson.

Teaching Aids

- Library Books
- Computers connected to the Internet
- Pens
- Notebook
- Internet
- Questionnaires
- Students with hearing impairment will be using computers with loud speakers.
- Parents can be encouraged to buy hearing gadgets for their children with hearing impairment.

Learning activities

The teacher divides the learners into groups and instructs them to research or discuss in order to find out the nutritional importance of cereals. Learners to find out the

nutritional importance of cereals, discuss, record and present their finding to class and take summary notes after consolidation by the teacher.

Synthesis

Teacher to guide learners to summarise the importance of cereal crops after the presentation of their findings (pages 78 - 81 of Student's Book).

Answers to table 2.1.

Cereal	**Importance**
Rice	(i) Staple food (ii) Livestock feed (iii) Starch for baby feeds (iv) Source of employment
Maize	(i) Staple food (ii) Foreign exchange (iii) Provide employment (iv) Livestock feeds (v) Produce cooking oil
Sorghum	(i) Human food (ii) Brewing industry (iii) Livestock feeds (iv) Traditional ceremonies
Wheat	(i) Human food (ii) Mulching materials (iii) Foreign exchange (iv) Making spirits (v) Source of employment (vi) Used in confectionery industries

Assessment

1. Discuss the nutritional importance of cereals:
   (i) Cereals contain 60% – 70% starch which is carbohydrates. Carbohydrates are the main source of energy for animals.
   (ii) Cereals are rich in proteins which are needed for the growth and repair of body tissues.
   (iii) Cereals contain vitamins particularly vitamin E.
   (iv) Cereals contain important minerals such as calcium, zinc, selenium and copper.

(v) Cereals contain oil which is an important source of energy. The oil is also extracted and used as cooking oil.

(vi) Cereals are used as fodder when grown at a more close spacing and harvested at flowering stage or when the kernels are at milk stage.

2. State three agricultural importance of cereals.

(i) Provide mulch (ii) Used as green manure (iii) Used as fodder

Lesson 3: Traditional practices of cereals

Learning objective

(a) Knowledge and understanding:
  (i) Explain traditional of cereals.

(b) Skills:
  (i) Conduct cereals cultivation.

(c) Attitude and values:
  (i) Show concern while doing cultivation techniques of cereals.

Prerequisites/Revision/Introduction

Teacher asks questions on the importance of cereals to review the previous lesson:

- Compare nutritional importance and agricultural importance of cereals.

Teaching Aids

- Hand hoe
- Questionnaire
- Rice and maize seeds
- Organic and inorganic fertiliser
- Sacs and sheeting
- Fertilisers
- Garden line

Learning activities

Supervised activity

The teacher provides questionnaires and organises for a field visit to a farm growing rice. Students then carry out cultural practices, discuss, record their findings and present reports to the class. The learners then take the teacher's summary notes.

The teacher to provide materials for maize production and instruct the learners to establish a crop of maize in a field measuring 4 m x 3 m. The teacher to supervise

the cultural practices carried out on the field. The learners record and discuss their finding and report to the class. Teacher assesses the activities as the project is ongoing. Students take teacher's summary notes.

Answers to Exercise 2.3

Diagram	Activity
1	Preparation of nursery
2	Flooding the nursery beds
3	Transplanting rice seedlings in flooded seedbeds
4	Lifting rice seedlings from the nursery beds

Exercise 2.4 table 2.3

Diagram	Activity
(a)	Irrigation canals carrying water to the rice fields
(b)	Manual weed control using hand hoes
(c)	Spraying rice with a fungicide
(d)	Manual harvesting of rice

Exercise 2.5 table 2.4

Diagram	Activity
(a)	Lodging in maize due to lack of earthing up.
(b)	Gapping in maize
(c)	Top dressing maize with a nitrogenous fertilizer
(d)	Overhead irrigation in maize
(e)	Chemical application in maize using a knapsack sprayer
(f)	Stooking maize
(g)	Shelling maize

Synthesis

Through demonstration, teacher to consolidate practical activities carried out by learners on cultural practices of rice and maize (page 85 number 4 of Student's Book).

Assessment

1. Describe the manual harvesting of maize for grains.
   - (i) Cut maize stalks that are dry.
   - (ii) Stook the maize stalks.
   - (iii) De-husk the maize cobs.
   - (iv) Dry the maize cobs.
   - (v) Shell the maize.
   - (vi) Sun dry the shelled maize grains to reduce moisture content.

2. Describe the process of transplanting and fertilisers

Transplanting of rice seedlings is carried when the puddled fields are levelled. At this stage, the water level is about 5 cm deep to allow the seedling roots to hold onto the mud. Double superphosphate fertiliser is broadcasted in the puddle fields at the rate of 120 kg per hectare. Sulphate of ammonia fertiliser is applied at the rate of 125 kg per hectare just before transplanting and 125 kg per hectare, 40 days after transplanting. seedlings are then transplanted at a spacing of 10 – 20 cm × 10 – 20 cm depending on the variety.

Lesson 4: Traditional practices of cereal/sorghum

Learning objectives

(a) Knowledge and understanding:
   (i) Explain traditional practices done on cereals.

(b) Skills:
   (i) Conduct cereal cultivation

(c) Attitudes and values:
   (i) Show concern while doing cultivation techniques of cereals

Prerequisites/Revision/Introduction

Teacher takes learners to the field to identify some diseases of maize crops as a review of previous lesson.

Teaching Aids

- Sorghum seeds
- Hand hoe
- School field
- Tape measure
- Pegs
- Garden line
- Organic and inorganic fertilizer

Learning activities

Supervised activity

The teacher to provide materials for sorghum production and instructs learners to establish a crop of sorghum in a field measuring 4 m x 3 m. The teacher to supervise the cultural practices carried out on the field. The learners record and discuss their findings and report to class. The teacher assesses the project as it is on-going. Students take the teacher's summary notes.

Answers

Exercise 2.6 table 2.5 (page 104 Student's Book)

Diagram	Varieties
1	Brown seeds/biter varieties
2	White seeded/sweet varieties
3	White seeded/sweet varieties
4	Brown seeded varieties

Exercise 2.7 (page 111 of Student's Book)

(a) Activity – Combine harvesting maize

(b) Drying sorghum heads

(c) Machine de-husking sorghum

(d) Hand/manual de-husking sorghum

Synthesis

Through demonstrations, teacher consolidates cultural practices of sorghum carried out by learners (page 101 - 110 of Student's Book).

Assessment

1. Elaborate a procedure of land preparation for sorghum.

   (i) Hand clearing

   Land should be prepared early during the dry season by slashing, tree felling, destumping, bush clearing to remove perennial, annual and biennial weeds. Raking is done to remove the crop residue and slashed weeds.

   (ii) Primary cultivation

   Primary cultivation is done by digging in small farm holdings or ploughing in medium to large farms. The ploughing should be done deeply to open the soil for aeration and infiltration of water. The surface trash and weeds should be buried completely. Ploughing should be done during the dry season to allow enough time for other farming operations to be carried out.

   (iii) Secondary cultivation

   Secondary cultivation after primary cultivation through harrowing and digging to achieve medium tilth. Harrowing is done by use of hand hoes and tractor or ox-drawn harrows.

2. Carry out weed control and earthing up in a field of sorghum.
   (a) Weeding
      – Done by tillage to remove annual weeds.
      – Weeds growing close to the plants should be uprooted.
   (b) Earthing up
      – Soil is placed at the base of the sorghum plant to provide support and encourage tillering.

Lesson 5: Traditional practices of cereals (wheat)

Learning objectives

(a) Knowledge and values:
   (i) Explain traditional practices done on cereals

(b) Skills:
   (i) Conduct cereals cultivation

(c) Attitudes and values:
   (i) Show concern while doing cultivation techniques of cereals.

Prerequisites/Revision/Introduction

Teacher asks learners the questions on cultural practices of sorghum to review the previous lesson:

- How land preparation for sorghum is carried out.

Teaching Aids

- Wheat seeds
- Fertilisers
- Hand hoe
- School field
- Tape measure
- Pegs

Learning activities

Supervised activity

The teacher provides questionnaires and organises for a field visit to a farm growing wheat. Students then carry out cultural practices, discuss, record their findings and present reports to the class. The learners then take teacher's summary notes.

Synthesis

Through demonstration, teacher guides learners to summarise cultural practice of wheat (page 110 - 116 of Student's Book).

Assessment

1. Demonstrate how wheat is harvested.

   Wheat is ready for harvesting after 4–5 months when the straw is yellow to brown in colour. Harvesting is done by machine using a combined harvester or by use of hand where a sickle is used to cut off the stems. The combined harvester combines both harvesting and threshing of the wheat.

Unit 3 Ornamentals

3.0 Key Unit Competence

Learners should be able to conduct cultivation of a range of ornamental plants.

3.1 Prerequisite knowledge and skills

Learners should have knowledge and practical skills in crop production such as nursery establishment and management, land preparation, transplanting/planting, fertiliser application, weeding, field maintenance practices and harvesting.

3.2 Cross-cutting issues to be integrated in the teaching and learning activities

The following are the emerging issues addressed by this unit:

(i) **Standardisation culture:** The unit develops learners' understanding as a pillar of economic development. The activities that they carry out in this unit should be done accurately to standard especially when they are able to apply right quantity of selected fertiliser accordingly. They will aim at becoming citizens of high lifestyles.

3.3 Generic competences:

- **Critical thinking and problem solving skills** – Learners will think deeply and broadly to evaluate and find the solutions of problems of insufficiency of flowers due to misunderstanding of farmers on cultural practices of ornamentals.
- **Research** – This will help learners to find answers to questions based on existing information while searching on internet or reading books in the school library.

3.4 Key terms

1. **Ornamental plants:** Plants grown for the purpose of decoration.
2. **Ornamental farming:** The growing of ornamental plants.
3. **Floriculture:** Branch of horticulture that deals with growing of flowers and ornamental plants.
4. **Horticulture**: Branch of Agriculture that deals with the growing of high value crops such as vegetables, flowers and fruits.
5. **Flower garden**: A garden where flowers are grown and displayed.
6. **Landscape:** The visible features of an area of land, its land forms and how they

integrate with natural and man-made features.

7. **Park:** An area of natural or planted space reserved for human enjoyment and recreation.
8. **Cultivar:** It is the cultivated variety of a plant that has been developed for a particular region by plant breeders.
9. **Cut flowers:** Flowers or flower buds that have been cut from the plant bearing it. Cut flowers are used for decorative uses at homes or in the ceremonies. They form the bulk of the flower industry.
10. **House plants:** These are plants that are grown indoors in homes and offices.
11. **Outdoor plants:** Plants grown in places where there is enough sunshine outside houses where there is no shading.
12. **Variegated plants:** Plants whose leaves have differently coloured zones.
13. **Epiphytes:** Plants that grow harmoniously upon other plants, mainly on tree barks.
14. **Terrestrial plants:** Plants that grow on land conditions as opposed to aquatic plants or epiphytes.
15. **Inflorescence:** A group or cluster of flowers arranged on a stem axis.
16. **Bract:** A modified leaf associated with a reproductive structure such as a flower.
17. **Fragrance:** A pleasant sweet smell.
18. **A bouquet:** An attractively arranged bunch of flowers especially one presented as a gift or carried at a ceremony such as a wedding.
19. **Spike:** A flower cluster (inflorescence) formed of many flower heads attached directly to a long stem.
20. **Spadix:** A spike of minute flowers closely arranged around a fleshy axis and typically enclosed in a spathe.
21. **Spathe:** A sheathing bract enclosing the flower cluster of some plants such as palm trees and members of the Araceae family e.g., Anthurium.
22. **Vegetative propagation:** This is the development of new plants from vegetative parts such as leaves, stems and roots. It is also known as cloning.
23. **Seed propagation:** Development of new plants from a seed.
24. **Herbicides:** Chemical substances used to kill unwanted plants in cultivated fields.
25. **Pre-emergence herbicides:** Herbicides applied before the planted crop appears up through ground surface. They are mainly non-selective.
26. **Post-emergence herbicides:** Selective herbicides applied after the planted crop emerges from the ground.
27. **Ornamental trees:** Trees used as part of a garden, park or landscape setting.
28. **Pruning:** Trimming a tree shrub or hedge by cutting away dead overgrown branches or stems to stimulate fresh growths.

29. **Budding:** This is the practice of uniting a vegetative bud known as the scion to the root stock of another plant.
30. **Grafting:** This is the practice of uniting two separate woody stems.
31. **Honedew:** A sticky substance produced by sucking insects as excreta which is eaten by sugar ants.

3.5 Problem statement: Guidance to the teacher

(a) Divide the learners into groups and instruct them to carry out the activities stated in Student's Book page 121.

(b) Assist them to identify the problems in the photograph as follows:
- Photograph (a) shows bougainvillea infested with a lot of weeds.
- Photograph (b) shows anthurium plant attacked by bacterial blight disease.

(c) Guide them in identifying the methods used to control the weed and disease problems they have identified so as to help the priest as follows:

(i) Control of weeds in bougainvillea:
- Uprooting
- Shallow cultivation
- Mulching
- Use of organic herbicides

(ii) Control of Bacterial blight disease in anthurium:
- Spraying with copper based fungicides.
- Destroying the affected plants.

(d) Help the learners to analyse the importance of the two problems in the church flower garden as follows:
- Importance of weeds in bougainvillea:
  - Compete for nutrients with the flower plants.
  - Reduce the flower production.
- Importance of Bacterial blight disease in anthurium:
  - Destroy the beauty of the plant leaves.
  - Reduce food manufacture of the plant making it weak and unable to flower.

(e) Allow the groups to present their findings to the class.

3.6 Suggestions for accommodating Special Education Needs (SEN)

When teaching this unit, special education needs learners can be assisted as follows:

Type of special need	Assistance to the learners
Visual impairment	• Use of large prints in the instruction sheets and assessment papers. • Allow the learners to sit near the chalkboard when in class. • Pair the special needs learners with those that have good vision.
Hearing impairment	• Be audible enough to the learners. • Ask them whether they have heard. • Allow them to stay close to the teacher.
Motor impairment	• Conduct group activities in one place to avoid too much movements. • Pairing them with other learners so as to be assisted in carrying heavy items.
Gifted or talented learners	• Assign them extra tasks such as writing and presentation of group reports. • Ask them to assist the slow learners. • Place them in different working groups.
Slow learners	• Giving them individual attention. • Remedial teaching. • Asking talented learners to assist them /peer teaching.

3.7 List of lessons

Lesson no	No. of periods	Weeks	Lesson title
1	1	Week 1	Ornamental definition and some ornamentals cultivated in Rwanda
2	1	Week 1	Importance of ornamental plants
3	2	Week 2	Propagation methods of ornamental plants

4	2	Week 3	Traditional practice of ornamentals
5	2	4th week	Traditional practices of ornamentals End of lesson assessment

3.8 Unit Summary

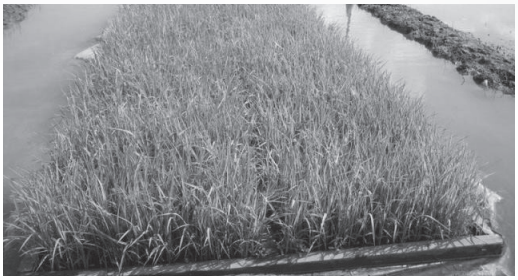
Ornamentals are plants which are grown for the purpose of decoration. They are used in beautifying the environment in which human beings live.
Ornamentals are grown in such places as the landscape, flower gardens, greenhouses and in containers. Trees become ornamentals only when they are tendered and used as part of a garden, park or landscape. The cultivation of ornamentals is known as floriculture. Importance of ornamentals include adding beauty, fragrance, attracting wildlife, cleaning the air, ceremonial and religious use. Ornamentals grown in Rwanda include roses, duranta, palms, anthurium and bougainvillea. Ornamentals are propagated through cuttings, budding, grafting, splitting, layering and seed.
Cultural practices in the growing of ornamentals include land preparation, planting, pruning, fertiliser application, watering, weeding, pest management, disease control and harvesting for ornamentals grown for cut flowers. Some ornamentals are used as indoor house plants while others are grown as outdoor plants where they display thei beauty.

3.9 Additional information for the teacher

Nursery establishment and management practices for ornamental plants.
The success of ornamental farming industry depend to a large extent on a reliable supply of good quality planting materials. Most ornamental plants are propagated vegetatively through cuttings, budding, grafting, splitting and layering while some are propagated through seed. Some of the suggested materials especially, cuttings are first placed in a nursery so as to develop roots before being transplanted to the main field/place where they are needed. Therefore, a nursery is very important in ornamental farming.

(a) **Types of nurseries**
There are different types of nurseries used in raising seedlings and other planting materials for ornamental farming. The most common ones include:
(i) Nursery beds
A nursery bed is a special seedbed prepared for raising seedlings before

transporting them to the main seedbed. It should be 1m wide and any convenient length depending on the quantity of seedlings or materials to be raised. Nursery beds are the most suitable for raising seedlings for large scale production.



Nursery bed

(ii) Seed boxes/containerised nurseries

In these type of nurseries, the nursery is established in a box or container prepared for that purpose. Garden soil or other rooting material is placed into the container and then watered before bringing in the seed or materials. Containerised nurseries are used for small scale production.

Containerised nurseries

(iii) Use of polythene sleeves/bags

Polythene sleeves are also used in raising seedlings. The sleeves are filled with soil and water. The seeds or materials placed in the sleeves are packed and placed in a crop propagation structure where management practices are carried out. This is the most common method of raising planting material of ornamental farming.

Seedlings in polythene sleeves

(b) **Nursery establishment**

(i) Procedure of establishing nurseries is as follows:
Select a suitable site for nursery establishment. In selecting a nursery site, the following factors should be put into consideration:

- Source of water: It should be near a reliable source of water.
- The type of soil: The soil should be fertile.
- Drainage: It should be sited in a well drained place.
- Availability of shelter: Should be in a well sheltered place to protect the seedlings from the heat of the sun.
- Previous cropping: Should be a place where plants of the same species had been planted before.

(ii) Clear the vegetation at the selected site and remove trash using a rake.

(iii) Mark out the dimensions of the nursery bed using pegs.

(iv) Plough or deeply dig the area to remove all weeds, roots, stumps and stones.

(v) Measure and divide the nursery into blocks of 1metre wide and any convenient length.

(vi) Leave a path about 50 cm wide between the beds to allow easy movement.

(vii) Carry out soil refinement to the required tilth for each individual bed.

(viii) Broadcast the phosphatic fertiliser into the beds.

(ix) Level the beds using a rake.

(x) Make drills or furrows (depending with the planting material) in the beds.

(xi) Place the seeds or planting materials in the beds.

(xii) Water the beds.

(xiii) Apply a thin layer of mulch.

The procedure of preparing seedlings in polythene sleeves:

(i) Select a suitable site for the vegetative propagation unit considering the following factors:

- Source of water
- The structure should be constructed near a reliable source of water for adequate watering of seedlings.
- Soil type
  The soil should be fertile and well drained.
- Sunshine
  The area should receive enough sunshine.
- Security
  The place should be well fenced to guard against thieves and livestock.
- Distance to the place where the plants will finally be established. The propagation unit should be near the fields to reduce time and labour

requirements in transporting the seedlings.

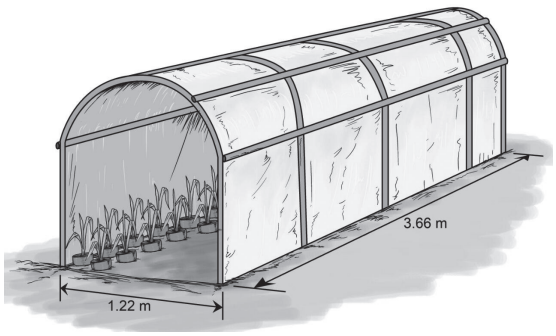
(ii) Clear the vegetation at the site and remove trash using a rake.

(iii) Mark out the area.

(iv) Level the land at the site.

(v) Construct a vegetative propagation unit as follows:

- Measure a length of 3.66 metres and a width of 1.22 metres. This space can hold about 1200 sleeves.
- Bend the 'fitos' or make a metal frame to form a inverted U-shape along the length of the unit as shown in figure 3.4

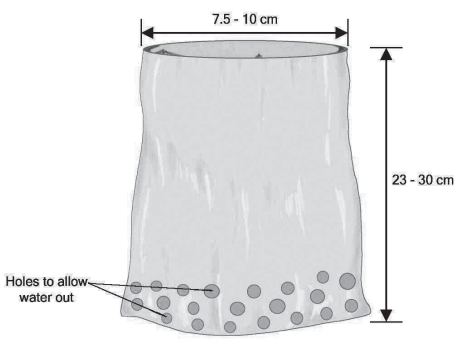


Vegetative propagation unit

- Make sure that both ends of the *'fitos'* or metal frame are firmly fixed into the ground.

(vi) Prepare the potting mixture for the sleeves using subsoil, double super phosphate and sulphate of potash.

(vii) Fill the mixture into the sleeves which should be about 75 cm to 10 cm in diameter and 23 –30 cm long.



Polythene sleeves

(viii) Arrange the sleeves in the vegetative propagation unit.

(ix) Prepare stem cuttings as follows:

- Obtain a shoot from the mother plant which has the desired characteristics.
- Use the middle part of the shoot discarding the soft top and the hard bottom end.
- Make cuttings of about 2.5 – 4.0 cm long each having a leaf and a bud.
- Put the cuttings in water to prevent dehydration.

(x) Water the sleeves and insert the cuttings at the centre in a slanting manner. Ensure the leaf does not touch the soil to avoid rotting.

Cuttings inserted in a polythene sleeve

(xi) Place polythene sheet or any other roofing material on the 'fitos' to form a roof.

(xii) Make sure that the ends of the polythene sheet are covered well under the soil.

(xiii) Construct a shelter over the vegetative propagation unit to reduce overheating by the sun.

(xiv) Water the sleeves once every three weeks.

Nursery management practices

(i) Watering– the nursery should be watered twice a day, morning and in the evening.

(ii) Removal of mulching material– This is done immediately the seedling starts to emerge and replacing it with an overhead shade.

Overhead shade in a nursery bed

(iii) Weedings – Weeds should be controlled through uprooting.

(iv) Pests and disease control – Apply appropriate pesticides to control pests and fungicides to control fungal diseases that mainly attack seedlings in nurseries.

(v) Thinning– Remove excess seedlings in nurseries to avoid overcrowding that may result in weak seedlings. This is especially so in nurseries.

(vi) Pricking out – The seedlings removed from the nursery bed before they are ready for transplanting are transferred into another nursery bed known as a seedling nursery.

(vii) Grafting – Tree seedlings should be grafted when they are pencil-thick in diameter as described in the Students' Book pages 144 - 146.

(viii) Hardening off seedlings – Reduce the frequency of watering and gradually remove shedding 7 – 10 days before transplanting. This is done to enable the seedlings develop tough stems so as to withstand field conditions after transplanting.

(ix) Transplant the seedlings when they are 15–20 cm for tree seedlings cuttings, should be transplanted when they have properly developed roots.

3.10 Suggested Answers to End of Unit 3 Assessment (pages 180 - 181 of Student's Book)

1. (i) Add beauty.

(ii) Produce sweet fragrance in the surroundings
Attract wildlife
Clean the air
Used for ceremonial and religious purposes

2. (i) C – Palm tree.
   (ii) B – Duranta
   (iii) A – Roses
   (iv) D – Anthurium
3. (a) Aphids – Suck plant sap
   (b) Mealy bugs – Suck plant sap
   (c) Loopers – Chew the leaves
   (d) Red plant weevils – Damage the stem when burrowing.
4. A – Petals
   B – Sepals
   C – Floral tube
5 (a) (i) Dig holes measuring 45 cm × 45 cm × 45 cm on the prepared land.
   (ii) Holes are dug at a spacing of 2.0 m × 1.0 m.
   (iii) Put 10 kg of well rotten manure which is mixed with a phosphatic fertiliser into each hole.
   (iv) Water the holes thoroughly.
   (v) Place the cuttings which had been dipped into a growth hormone solution at the centre of each hole.
   (vi) Back fill the hole with top soil.
   (vii) Firm the soil around the cutting.

   (b) (i) Use Bio-fertilisers at the rate of 2 kg of Azospirillum and an equal amount of phosphobacteria per hole at the time of planting.
   (ii) Apply manure at the rate of 10 kg farmyard manure per plant after pruning.
   (iii) Apply foliar feed at the rate of 0.2% micronutrient mixture containing 20kg $MnSo_4$ 15 g $MgSo_4$, 10g Fe So_4 and 5g B. The foliar spray is prepared by mixing 2 g of the mixture in every one litre of water.

   (c) (i) Apply water once in two days until the plants are established and thereafter once a week.
   (ii) Use fresh water in watering the plants.

   (d) (i) Apply a 5–10 cm layer of organic mulch on the ground to reduce weed growth/smother weeds.
   (ii) Uproot weeds growing around the plants.
   (iii) Use hand tools to remove weeds by shallow cultivation in the fields.
   (iv) Apply herbicides to kill weeds in the Rose fields as follows:

   Pre-emergence herbicides applied before the weeds emerge or after weeds have been removed and before others germinate. This is usually done before

planting.

- Post-emergence herbicides are applied to control established grass weeds.

(e) (i) Harvest Roses at the tight bud stage when the colour is fully developed and the petals have not started unfolding.

(ii) Harvest roses using secateurs.

(iii) Leave 1– 2 mature leaves on the plant to encourage production of new strong shoots.

(iv) Harvest roses during early morning hours.

(v) The cut-flowers should have a few leaves and a stalk.

6. (a) Rust disease.
   (b) Controlled by spraying using appropriate fungicide.

Remedial activities for slow learners

1. The following are ornamental plants grown in Rwanda:

   A – Anthurium

   B – Roses

   C – Bougainvillea

   D – Palm trees

   Which of the above ornamental plants is mainly grown for its attractive leaves rather than the flowers?

   Answer: D

2. Name three categories of stem cutting:

   (i) Soft wood cuttings.

   (ii) Semi-hardwood cuttings.

   (iii) Hardwood cuttings.

3. What is layering?

   A method of propagation where a part of a plant is induced to produce roots while still attached to the mother plant. The part is then cut and used as a planting material.

4. Name two types of mulching materials used in the growing of Roses:

   (i) Organic mulch

   (ii) Inorganic mulch

5. Identify the type of grafting illustrated by the following diagram:

Extension activities for gifted and talented learners

1. Explain how temperature, relative humidity, light intensity, oxygen supply, chemical treatment and leaf area affect the rooting of cuttings.
   - *(i) Temperature – Cutting require warm temperatures around the root zone and cool temperatures for the aerial part so as to produce roots.*
   - *(ii) Relative humidity – Proper rooting of cuttings require high humidity which lowers the transpiration rate and increases leaf turgidity. The rooting of the cuttings should therefore be carried out under shady conditions where relative humidity can be regulated.*
   - *(iii) Light intensity – Soft wood cuttings require light of high intensity to promote photosynthesis while hard wood cutting which have high amount of stored carbohydrates root fast in dark conditions.*
   - *(iv) Oxygen supply – Cutting requires adequate supply of oxygen for them to develop roots. The rooting media should therefore allow proper aeration.*
   - *(v) Chemical treatment – Rooting hormones induce root production in cuttings.*
   - *(vi) Leaf area – Soft wood cuttings require a lot of leaves for photosynthesis while hardwood cuttings will produce roots faster without leaves.*
2. Give three types of hormones used to induce the rooting of cuttings:
   - *(i) Indoleacetic acid/IAA*
   - *(ii) Indolebytyric acid /IBA*
   - *(iii) Naphthalene acetic acid /NAA*
3. Explain how heat treatment helps to break seed dormancy.
4. Explain the importance of mulching in ornamental farming:
   - *(i) To conserve soil moisture.*
   - *(ii) To control weeds.*
   - *(iii) To moderate soil temperatures.*
   - *(iv) To reduce the impact of splash erosion.*
   - *(v) Organic mulch decompose to add nutrients into the soil.*
   - *(vi) They prevent the baking of the soil by the heat of the sun.*
5. Describe three parts of the Anthurium plant that make it very attractive:
   - *(i) Leaves — These are heart shaped with a beautiful deep green colour.*
   - *(ii) Spathes — These have bright beautiful colours.*
   - *(iii) Spadix —An elongated spike with small flower in dense spirals around it.*

3.11 Structure of every lesson

Lesson 1: Some ornamental plants cultivated in Rwanda.

Learning objectives

(a) Knowledge and understanding:
  (i) Define ornamental plants
  (ii) Give examples of ornamentals in Rwanda.

(b) Skills:
  (i) Recognize the meaning of ornamental plants.
  (ii) Select common ornamental cultivated in Rwanda.

(c) Attitudes and values:
  (i) Take care to find the significance of the ornamentals.
  (ii) Notice the main ornamentals grown in Rwanda.

Prerequisites/Revision/Introduction

The teachers introduces the lesson by asking learners to list different crops/plants they know.

Teaching Aids

- Ornamentals garden/compound
- Notebooks
- Library books
- Pens
- Questionnaires
- Computers connected to the internet

Learning activities

Discussion and Field visit

Teacher divides the class into groups, provides reference materials and instructs them to find out the meaning of ornamentals. Teacher supervises the discussions. Learners give their opinion freely, record and present their findings to the class. Teacher concludes the lesson by giving summary notes.

Teacher provides a questionnaire as shown in Annex 10 to the learners and instructs them to observe and identify ornamental plants grown in the farm. Teacher controls the learners and maintains discipline. Learners make observations and identify the ornamentals in the farm, discuss, record and present their finding to the class. Teacher then concludes by giving summary notes.

Answers to Exercise 3.1

Ornamental Plant	Name
(a)	Rose flower
(b)	Duranta plant
(c)	Palm tree
(d)	Potted Anthurium plant
(e)	Bougainvillea tree

Synthesis

Teacher guides learners to come up with a summary of their findings on some ornamental plants grown in Rwanda (pages 123 – 130 of Student Book).

Assessment

1. What is an ornamental plant?
   Ornamentals are plants or trees grown for the purpose of decoration. They have an attractive appearance. They are used in beautifying the environment in which human beings live. They are used to beautify the landscape and flower gardens. Trees become ornamentals only when they are tendered and used as part of a garden, park or landscape setting. If ornamental plants are not tendered, they cease to be ornamentals. The cultivation of ornamentals is known as floriculture or simply flower farming. Floriculture is a branch of horticulture.
2. Describe characteristics of anthurium flower.
   Anthurium is a herbaceous monocotyledonous perennial plant. it is an evergreen flowering plant that belongs to the araceae family. The family has over 800 species which are mainly epiphytes with a few terrestrials.
   (i) Inflorescence – The inflorescence also known as the spadix bears small flowers which contain both male and female structures. The flowers are contained in dense spirals on the spadix which is elongated to form a spike.
   (ii) Spathe – This is a type of a bract. the spathe is of variable shape in many species but is mainly lance shaped. The spathe may extend out flat or in a curve.
   (iii) Leaves – The leaves are heart-shaped and deep green.
   Anthuriums are grown for their brightly coloured spadix, spathes and beautiful leaves. The spadix and the spathe are the main focus of anthurium breeders who develop cultivars with bright colours and unique shapes. Many anthuriums are grown as house plants although some are grown as outdoor plants in mild climates and shady spots. Anthuriums can be propagated by seed or vegetatively by cutting.

Lesson 2: Importance of ornamental plants

Learning objectives

(a) Knowledge and understanding:
  (i) Discuss the importance of ornamental plants

(b) Skills:
  (i) Recognise the importance of ornamental plants

(c) Attitude and values:
  (i) Appraise the importance of the ornamental plants

Prerequisites/Revision/Introduction

Teachers asks learners questions on some ornamentals grown in Rwanda:

- List any four ornamentals grown in Rwanda.

Teaching Aids

- Flower garden
- Computers connected to the internet
- Library Books
- Pens
- Notebooks
- Questionnaire
- Internet

Learning activities

Research and discussion

Teacher divides the learners into groups, provides the reference and instructs the learners to find out the importance of ornamental plants. Teacher supervises the discussions. Learners give their opinions, record and present their findings to the class. Teacher concludes the lesson by giving summary notes.

Synthesis

The teacher consolidates the findings of learners on importance of ornamentals as a summary of the lesson (pages 131 – 133 of Student's Book).

Assessment

Explain how ornamental plants attract wild life.

Some ornamental plants provide nutrition and shelter for many wildlife animals such as birds and insects. These animals get attracted to ornamental plants for livelihood. In the process, some of these animals such as bees and birds help in cross pollination and propagation of the plants. This makes the attractiveness of the ornamental plants beneficial to the ecosystem. The berry producing ornamentals such as hawthorn and crabapple are good examples.

Lesson 3:Propagation methods of ornamental plants

Learning objectives

(a) Knowledge and understanding:
  (i) Explain the different methods of ornamentals propagation

(b) Skills:
  (i) Conduct propagation methods of ornamental plants

(c) Attitude and values:
  (i) Be careful when watching video by following all the steps of each activity.

Prerequisites/Revision/Introduction

Teacher asks learners the questions on importance of ornamental plants to review the previous lesson:

- Explain how ornamentals may clean the air.

Teaching Aids

- Video on propagation method
- Notebooks
- Pens
- Garden tools

Learning activities

Video show

Discussion: Teacher organises for a video show on methods of propagating ornamental plants and instructs the learners to identify methods of propagating ornamentals from the video show.

Learners watch the video, discuss, record and present their findings to the class. Teacher concludes the lesson by giving summary notes.

Synthesis

Teacher guides learners to summarise their findings on propagation methods of ornamentals (pages 133 – 148 of Student's Book).

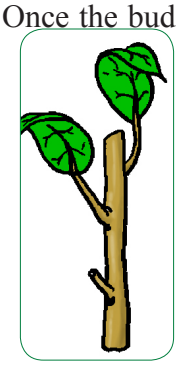
Assessment

1. Using diagrams, show procedure of ornamentals' propagation (T-budding)

   In this method, the rootstock is prepared by making a T-shaped incision through the bark down to the wood. The T-shaped incision is made 15 cm – 20 cm above the ground

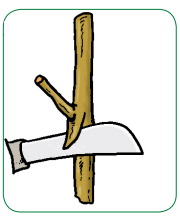
using a special sharp knife known as budding knife. The bark is then raised and the bud inserted. This is done by sliding the bud downwards under the lifted bark until it lies between the edges of the bark and is well done below the horizontal incision. The bud is then firmly tied using either a budding tape, rubber strips or polythene strips.

The wrapping is removed about two weeks after budding in order to inspect the bud. If it is green, then it has been accepted by the rootstock. Once the bud develops into a shoot, the shoot of the rootstock is cut about 1 cm – 2 cm above the union. When the young shoot is above 25 cm, it is supported through staking to prevent it from being destroyed by wind.



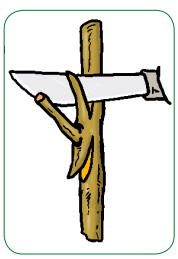
Propagation of roses through T-budding

The following is the procedure of propagating roses through T-budding:



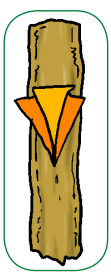
(i) Prepare the rose plant that you intend to bud. This is done by trimming the plant down to about 45 cm from the ground level.

(ii) Prepare the buds. This is done by selecting and cutting bud sticks from the previous year growth. The bud stick is a cutting that has about 4–6 fully developed buds cut from a plant with desired characteristics, for example, flower colour.



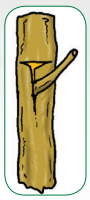
The bud sticks are placed in water for several hours.

(iii) Cut the buds. Use craft knife or razor blade to carefully slice the buds from the bud sticks. Take a reasonable size slice about ½ inch long. Use your knife to remove the hard section out of the bud.



(iv) Make a T-cut in the rose plant to be budded. Make two cuts, one horizontal and another vertical to make a T-cut on the plant to be budded. The horizontal and vertical cuts should be about 1

inch. The cuts should be deep enough to reach the combining layer. However, the cut should not go through this layer.



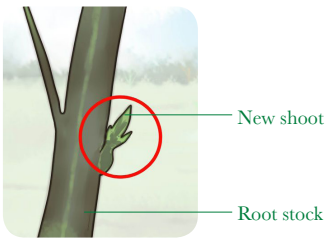
(v) Peel back the flaps of the T-cut just enough to see this layer.

(vi) Slid the bud downward under the peel bark until it lies between the edges of the bark and is well below the horizontal cut.

(vii) Bind (tie) the bud

Tie the bud firmly to the stock using a budding tape.

Once the bud has formed a successful union with the stock, reduce the top foliage. cut the stock about 1 – 2 above the stock when the bud has produced a shoot of about 25 cm high.



Note: budding in done in the afternoon so as to give them an overnight to settle before being exposed to the scorching sun.

2. Identify the type of grafting illustrated by the following diagram
Answer: Bark grafting

Lesson 4: Traditional practices of ornamentals (roses, duranta palms)
Learning objectives

(a) Knowledge and values:
(i) Explain the traditional practices done on ornamental plants.

(b) Skills:

(i) Conduct ornamental cultivation
(ii) Vary out the pruning for some cultivated ornamentals

(c) Attitudes and values:
(i) Avoid risks when conducting traditional practices

Prerequisites/Revision/Introduction

Teacher introduces the lesson by asking learners to point out main cultural practices to be carried out while growing a given crop.

Teaching Aids

- Hand hoe
- Forked hoe
- Seedlings of ornamentals
- Pruning knife
- Secateurs , pair of secateurs
- Pesticides

Learning activities

Field visit and practical work

Teacher prepares a field trip, provides a questionnaire as shown in Annex 11 to the learners and instructs them to observe and identify cultural practices carried out in Rose farms. Teacher controls the learners and ensures discipline. Learners observe, discuss, record and present their findings to the class. Teacher concludes by giving summary notes.

Teacher prepares for a field trip, provides a questionnaire as shown in Annex 12 to the learners and instructs them to observe and identify cultural practices carried out on Duranta plants and Palm trees. Teacher controls the learners and ensures discipline. Learners observe, discuss, record and present their findings to the class. Teacher concludes by giving summary notes.

Synthesis

Through demonstration teacher consolidates the findings of learners on traditional practices carried out on roses, Duranta and palms (pages 149-163 of Student's Book).

Assessment

Describe the procedures of pruning Duranta.

Answer

(i) Clean the pruning sheers before pruning and between cuts where the plant has a disease to prevent disease spread.

(ii) Cut away dead, damaged, old or diseased branches at the base of the tree.
(iii) Cut overgrowth back to a desirable shape and size.
(iv) Cut off branches that grow close to the ground.
(v) Remove water sprouts and suckers from the base of the tree.

Lesson 5: Traditional practices of ornamentals (anthurium and bougainvellea

Learning objectives

(a) Knowledge and understanding:
  (i) Explain the traditional practices done on ornamental plants.
(b) Skills:
  (i) Conduct ornamental cultivation
  (ii) Carry out the pruning for some cultivated ornamental
(c) Attitudes and values:
  (i) Avoid risks when conducting traditional practices.

Prerequisites/Revision/Introduction

Teacher asks learners to list all traditional methods to be carried out while growing roses, duranta and palms.

Teaching Aids

- Hand hoe
- Forked hoe
- Seedling of anthurium and bougainvillea
- Pruning knife
- Pair of secateurs
- Chemicals (pesticides)

Learning activities

Field trip with practical activities

Teacher prepares for a field trip, provides a questionnaire as shown in Annex 14 to the learners and instructs them to observe and identify cultural practices carried out on Bougainvillea plants. Teacher controls the learners and ensures discipline. Learners observe, discuss, record and present their findings to the class. Teacher then concludes the lesson by giving summary notes.

Synthesis

Through demonstration, the teacher consolidates the findings of learners on traditional practices carried out on anthurium and bougainvillea (pages 163 - 176 Student's Book).

Assessment

1. Describe the procedure of transplanting bougainvillea seedlings, established in polythene sleeves into the field.

   Answer

   Use of polythene sleeves/bags

   Polythene sleeves are also used in raising seedlings. The sleeves are filled with soil and water. The seeds or materials placed in the sleeves are packed and placed in a crop propagation structure where management practices are carried out. This is the most common method of raising planting material of ornamental farming.

2. Match the pests given in set A below to the damage they cause as shown in set B.

   Set A

   (a) Aphids
   (b) Mealy bugs
   (c) Loopers
   (d) Red palm weevils

   Set B

   (i) Uproot young seedlings
   (ii) Chew the leaves
   (iii) Suck plant sap
   (iv) Defoliate the plants
   (v) Damage the flower petal
   (vi) Damage the stem when burrowing

   Answer

   (a) Aphids— Suck plant sap
   (b) Mealy bugs— Suck plant sap
   (c) Loopers— Chew the leaves
   (d) Red plant weevils— Damage the stem when burrowing.

Unit 4 Fodder

4.0 Key Unit Competence

Learners should be able to successfully conduct cultivation of fodder grasses.

4.1 Prerequisite knowledge and skills

Learners should have knowledge and practical skill in crop production such as land preparation, planting, fertiliser application, weed control, field maintenance practices and harvesting.

4.2 Cross-cutting issues to be integrated in the teaching and learning activities

(i) **Peace and value education:** When young people/learners carry out traditional practices on fodder crops especially in lesson 4 and 5 they will acquire peace and value education while using slanting materials carefully not to injure their classmates and themselves.

(ii) **Environmental and sustainability:** This unit helps the learners to be competent in sustaining soil fertility when they grow fodder grasses. This maintains the environment as well as produce food for livestock to avoid overgrazing which bring environmental degradation.

(iii) **Inclusive education:** Working together in groups when carrying out production of fodder grasses helps each individual to participate and contribute to the welfare of the group. Each individual has a part to play regardless of their gender or ability.

(iv) **Standardisation culture:** Using accurate measurement spacing and seed rate in fodder production help learners to maintain high standards in production and in future will always aim at achieving high standards.

4.3 Generic competences:

- **Critical thinking and problem solving skills** – While analysing the problem stated on page 185 in Student's Book, learners will think imaginatively, innovatively and broadly to evaluate and find solutions to problems encountered in our surrounding.
- **Research** – This will help learners to find answers to questions based on existing information while searching on internet and reading library books.
- **Communication in official languages** – Teachers, irrespective of being language

teachers, will ensure the proper use of the language of instruction by learners. The teacher should communicate clearly and confidently and convey ideas effectively through spoken and written modes by applying appropriate language and relevant vocabulary.

4.4 Key terms

1. **Smother:** Kill weeds by covering to suffocate and prevent sunlight from reaching them.
2. **Biomass:** Total dry quantity of materials produced by a plant species per unit area of land.
3. **Root exudates:** Substances released from plant roots system depending on the surrounding environment and the need for them to kill weeds, pests or diseases.
4. **Germination potential:** The ability of seeds to germinate given proper condition.
5. **Certified seeds:** Seeds which have been tested and established to have the required qualities.
6. **Setts:** Canes or stems for planting which have been cut or prepared to be of the same size as required.
7. **Clump:** Cluster of grass from the same stem.
8. **Culm:** The hollow stem of a grass or cereal plant.
9. **Herbage:** The succulent part of herbaceous vegetation used to feed animals.
10. **Pasture:** A land cover of grass and legume species for grazing animals.
11. **Palatability:** Appetising or acceptable and agreeable to taste.
12. **Internodes:** A part or space between two nodes or joints as in the stem of a plant.
13. **Nodes:** The joints on the plant stems that hold one or more leaves as well as the buds which grow into branches.
14. **Hydrocyanine:** A potentially poisonous organic substance found in certain plants.
15. **Crude protein:** The total protein content in a feeds stuff determined by its nitrogen content.
16. **Crude fibre:** A measure of the quantity of indigestible cellulose and hermicellulose present in a feedstuff.
17. **Dry matter:** The material that remains after removing water which represents the nutrients in a feedstuff.
18. **Bloom stage:** Flowering stage of a plant.
19. **Zero grazing:** A system of livestock production in which the animals are confined and food and water brought to them.
20. **Cut and carry method:** The practice of cutting the fodder from the field and bringing to animals in confinement.
21. **Defoliation:** This refers to the grazing or cutting fodder or the removal of the foliage material from fodder or pasture.
22. **Molasses:** The thick dark brown syrup obtained from raw sugar during processing

which is fed to animals as a feed additive for energy.

23. **Varieties:** These are cultivated plants when considered as a group.
24. **Cellulose:** Indigestible fibre which is the main constituent of a plant cell wall. It is only digested by ruminants.
25. **Polysaccharide:** Complex carbohydrates made of several units of simple sugars such as glucose.
26. **Ruminants:** Animals that are able to digest coarse fibre found in plant tissues.
27. **Tillers:** These are side shoots of a plant that grow from the base of the main shoot or stem. They are common in grass family.
28. **Succulent plants:** Plants with thick fleshy leaves.
29. **Conserved fodder:** Forage materials cut and preserved for future use.
30. **Clones:** Plants derived from vegetative parts.
31. **Sterile:** Unable to produce viable seeds or produce off-springs.
32. **Toxic effect:** Poisonous.
33. **Prussic acid:** An organic substance that is metabolised by animals to form cyanide which is poisonous.
34. **Tendrils:** Growths from nodes that twine around hard parts of other plants to support same herbiceous.
35. **Fungicides:** Chemicals used to control fungal diseases.
36. **Insecticides:** Chemicals used to kill any insect pests.
37. **Selective herbicides**: Chemicals which kill certain plants and leave others.
38. **Pure stand:** A crop that is planted alone on a piece of land.
39. **Mixed stand:** A mixture of plants grown together on the same piece of land.
40. **Single cut:** A fodder that dries up after the first harvesting.
41. **Multiple cuts:** A fodder that sprouts after every harvesting to give several harvests.
42. **Hybrid:** A cross between two different varieties of a plant.
43. **Double cut:** Sprouting after the first harvest to give another harvest and then it dries up.
44. **Mesh sulphur powder:** An organic substance containing methionine sulphur and hydrogen.

4.5 Problem statement: Guidance to the teacher

(a) Divide the learners into groups and instruct them to observe the photographs given in Student's Book page 183 - 184.

(b) Assist the learners to explain what is happening in each photograph as follows:

- Photograph 1 – A ranch without enough fodder leading to emaciated unhealthy animals.
- Photograph 2 – A heap of napier grass chopped into small pieces.
- Photograph 3 – Healthy and huge animals reared under an intensive system with sufficient fodder.

(c) Guide the learners in finding out the cause of emaciation of the cattle in photograph 1 due to lack of enough fodder to eat. The reason for making fodder into the farm shown in photograph 2 is to help the animal eat fodder with ease.
(d) Help the learners understand the solutions to the problems in photographs 1 and 2 as:
- Lack of enough land to grow the fodder.
- Growing fodder grasses which are not high yielding and so low supply of feeds.
- Lack of conserving the fodder when it is in plenty.
- Giving the animals fodder before chopping it.

(e) Assist the learners to propose sustainable solutions to the challenges they have observed.

Such solutions are:
(i) Selection of high yielding fodder.
(ii) Using the recommended methods of propagating fodder.
(iii) Carrying out important cultural practices in the growing of fodder.
(iv) Harvesting of fodder at the correct stage.
(v) Conservation of fodder when it is in plenty to prevent wastage.
(vi) Allow the groups to present their findings to the class.

4.6 Suggestions for accommodating Special Education Needs (SEN)

Learners with special needs should be identified and be actively involved in all activities. This can be done by identifying the type of special need and the support they require. This is summarised in the table below:

Type of special needs	Support for the learners
Sensory impairment (hearing)	• Ask learners to sit close to the teacher. • Speak loudly so that all learners can hear. • Seek for the learners' attention.
Physical impairment (visual)	• Use large prints in practical sheets and questionnaires. • Provide enough space for braille machine for those using them. • Pair them with the sighted learners for assistance.
Sensory impairment (motor)	• Provide enough space for the wheelchairs in class in case of those using them. • Conduct activities in one area to avoid a lot of movement. • Assign other learners to help them.

Gifted or talented learners	• Assign them tasks such as collecting practical materials. • They can prepare and present group findings. • Paired to those with special needs to assist them.
Slow learners	• Be allowed more time to perform their tasks. • Assisted with performing tasks. • Attach them to the talented learners.

4.7 List of lessons

Lesson no	No. of periods	Weeks	Lesson title
1	1	1st week	Definition of fodder grasses Some fodder grasses cultivated in Rwanda
2	1	1st week	Importance of fodder grasses
3	2	2nd week	Propagation methods of fodder grasses
4	2	3rd week	Traditional practices of fodder grasses
5	2	4th week	Traditional practices of fodder grasses End unit assessment

4.8 Unit Summary

The most important source of food for livestock is roughage especially from green fodder. This fodder should be of good quality. Animals require fodder from both legumes and grasses.

Fodder grasses are forage crops which are cultivated for feeding livestock. They include grasses such as napier, Guatemala, brachiaria, columbus and Sudan grass. Multipurpose crops grown for human grains as well as for fodder include maize, oats and millet. Apart from supply of feeds for livestock, fodder grasses provide support for climbing plants in case they are intercropped, maintain soil fertility and are used in soil conservation.

Most of the fodder grasses produce viable seeds which are used for propagation. However, there are some grasses which are propagated vegetatively by cuttings and layering methods. These crops require proper management during their growth and so several cultural practices are carried out to ensure high

productivity. These include proper and timely planting, weed control and harvesting at the right stage. They can be fed when green or conserved as hay or silage.

4.9 Additional information for the teacher

The principles of preservation of fodder in form of silage

If the chopped forage undergoes aerobic respiration during the ensiling process, it utilises the available soluble carbohydrates from the herbage material concerned. This lowers the quality of silage made. Aerobic respiration should, therefore, be reduced as much as possible by compaction and rapid filling. When the silo is finally sealed, the oxygen supply is cut off and aerobic respiration gradually gives way to fermentation. This allows the lactic acid forming bacteria (*Lactobacillus spp*) to increase rapidly within the first 3–4 days after the silo is sealed.

Lactic bacteria act on the readily available carbohydrates to produce lactic acid and limited amounts of acetic, propionic, farmic and succinic acids. Lactic acid concentration may be 8 to 9% of the dry matter and this reduces the forage pH from 4 to 2 or below. Low PH inhibits further bacteria growth and preserves the silage. The ensiling process is complete in 2 to 3 weeks depending on the quantity of ensiled material and may be preserved for many years, provided the silo is water and air tight.

Use of additives in making silage

Maize and other cereal fodder crops (oats and pearl millet) do not need additives. They are harvested at the dough stage with a high supply of carbohydrates for proper fermentation. The other plants, for example, Napier grass Brachiaria, and Guatemala grasses need addition of more carbohydrates. Such additives include crushed grains at a rate of 100 kg per ton of silage, or molasses at 20 to 40 kg per ton of silage evenly distributed at the time of ensiling.

Silage Losses
The main silage losses are:

(a) Surface Spoilage
Up to 20% loss due to exposure and contact with soil.

(b) Seepage Losses
Extent of the loss increase in herbage moisture and can be up to 50% in very young and succulent forage especially if the silo is not watertight.

(c) Gaseous Losses

Extended respiration results in loss of carbohydrates in form of carbon dioxide (CO_2). The silo should be airtight.

How to Calculate Silage Requirements in Dry Matter

A cow requires 3kg of dry matter (DM) for every 100kg of body weight per day.
This means that, a cow weighing 400kg would require:

$$\frac{400}{100} \times 3 = 12 \text{ kg of dry matter per day}$$

Silage has 40% dry matter.
This means that for the cow to have the 12 kg of DM it needs:

$$\frac{12}{40} \times 100 = 30 \text{ kg of dry matter per day}$$

However, a cow should only get 50% of its daily DM requirements from silage. It should get the other 50% from pastures or other feeds. The cow should therefore get only 15kg of silage per day. If silage is to be made for the dry season when there is little pasture, the farmer should estimate the length of the dry period, for example from January to March. These are 90 days. So silage requirements for one cow for 90 days will be:

$90 \times 15 = 1350$ kg of silage.
$= 1.35$ tonne.

One hectare of napier produces 25—30 tonne of dry matter per hectare per year. This is approximately 80 tonnes of forage harvested in 5 cuttings in the year. One cutting therefore yields:

$$\frac{80}{5} = 16 \text{ tonne of silage}$$

To get 1.35 tonne of silage, therefore requires:

$$\frac{1.35}{16} = 0.084 \text{ hectares}$$

$= 840$ sq. metres.
$=$ A space of 30×30 metres.

Silage density is approximately 500kg/m^3.
If a farmer has two cows the amount needed is 2 cows × 15 kg × 90 days = 2700 kg.

The volume of the silo to accomodate 2700 kg would be approximately 6 m^3. The silo

would, therefore, have the following alternative dimensions:
(i) 2.7 m length × 1.5 m width × 1.5 m depth or
(ii) 3 m × 2 m × 1 m or
(iii) 4 m × 1.5 m × 1 m

4.10 Suggested Answers to End of Unit 4 Assessment (page of Students Book)

1. (i) Preparation of the baling box which should be 85 cm long × 55 cm wide and 45 cm deep with open top and bottom.
   (ii) Place two strong strings inside both ends of the box.
   (iii) Compact the hay inside the box to remove most of the air.
   (iv) Tie the hay at both ends with the strings tightly.
   (v) Push the hay bales forcefully from the box and store in a protected area.
2. The fodder harvested at the correct stage of growth which is at flowering stage:
   (i) High amounts of nutrients which include crude proteins.
   (ii) Enough crude fibre which animals can handle without any problems.
   (iii) Is palatable and agreeable to the animals.
   (iv) Harvesting at the right stage allows sprouting of more fodder or planting of another crop in time.
3. (a) A – Maize
   B – Sorghum
   C – Oat crop
   (b) C/Sorghum
   (c) It should be dried or wilted before feeding it to the animals.
   (d) A – harvested at dough or milky stage.
   B – harvested when the grain reach early to late dough stage.
   (e) (i) At this stage the maize has the highest nutritive value sorghum, also has high nutritive value and less prussic.
4. (i) Fodder is conserved for a long time as silage without losing its quality.
   (ii) There is no storage problem since the silos cannot prevent other field operations to take place.
   (iii) Silage is more palatable to livestock and eaten completely without any waste.
5. "Tumbukiza" method of planting Napier grass is carried out as follows:
   (i) Dig a round or rectangular hole known as a pit of 60 cm deep, 60–90 cm wide and any length.
   (ii) The pits should be dug 100 cm away from each other.
   (iii) Separate the top soil with the sub-soil.
   (Iv) Mix the top soil with a lot of manure.
   (v) Refill the hole with the mixture.
   (vi) Leave a space of 15 cm unfilled at the top of the pit.

(vii) Plant 5–10 cane cuttings or single root splits into the pits.

6. (i) Growing the fodder maize – a variety of maize that produces large quantity of herbage is chosen.
   (ii) Site selection – site for the silo should be slopy and well drained.
   (iii) Digging the pit – should have a slender than top.
   (iv) Harvesting the crop – This is done when the maize is at milky stage at its highest nutrient value and highly digestible.
   (v) Lining the silo pit – This is done with polythene sheet to prevent water seepage.
   (vi) Filling the silo with chopped fodders – Maize stalks are chopped into pieces of 2.5 cm filled into the pit and compacted.
   (vii) Adding molasses – This is added to increase fermentation.
   (viii) Adding more fodder – Fodder is added until it forms a dome shape.
   (ix) Covering with polythene sheet – To prevent moisture entering.
   (x) Covering with soil – A thin layer of soil is placed on the polythene sheet to fully cover the silo.

4.11 Remedial activities for slow learners

1. Name two types of fodder sorghums:
   (i) Columbus grass (Columbus almum)
   (ii) Sudan grass (Sorghum Sudanense)
2. (a) At what stage should fodder be harvested?
   Fodder grasses should be harvested when about 50% of the crop has flowered.
   (b) Give two reasons for the answer given in 2 (a) above.
   (i) Fodder has the highest nutritive value.
   (ii) It is easily digested since it has the right percentage of crude fibre.
3. (a) Mention the fodder grass which has poisoning effect to animals if fed when young and wet.
   The Sorghums, French Cameroon and Sudan grass.
   (b) Give reasons for your answer in 3(a) above
   It contains an alkaloid substance which releases hydrocyanic or prussic acid which is toxic to animals if eaten when wet.
4. List three methods of propagating fodder grasses:
   (i) Using seeds.
   (ii) Using cuttings.
   (iii) Through layering.

5. Identify three cultural practices carried out when growing Brachiaria grass which is commonly known as 'Mulato'
   (i) Planting.
   (ii) Weeding.
   (iii) Harvesting.

4.12 Extension activities for gifted and talented learners

1. Describe the process of making hay using Tripod method.
   (i) Fodder grass is harvested when 50% of the crop has flowered.
   (ii) The fodder is cut about 10–25 cm above the ground to leave foliage for sprouting.
   (iii) Cut fodder is spread under shade on the ground to dry or spread for curing.
   (iv) The fodder is turned every 4–5 hours to ensure even drying for the next 2–3 days.
   (v) A tripod stand structure is then constructed.
   (vi) The ground under the tripod is cleared and lined with dry grass, maize stalks or straws to prevent water seepage into hay.
   (vii) Hay is packed and compacted in layers inside the tripod.
   (viii) Every layer of hay that is compacted is held back by tying with strings before more hay is added, compacted and tied.
   (ix) The process is repeated until the tripod is completely filled, compressed and tied.
   (x) A layer of hay is used to cover all the sides to prevent entry of water and scorching by the sun.
2. Explain the ways in which fodder grasses help to improve soil fertility.
   (i) They prevent soil nutrients from being leached by holding them with their fibrous roots.
   (ii) They have high nutrient use efficiency hence do not easily exhaust the soil.
   (iii) They produce high organic matter content in the soil improving soil structure.
   (iv) They smoother weeds effectively preventing soil exhaustion.
   (v) Fodder left over after feeding animals is used to make high quality manure for use on the land.
   (vi) Wasted fodder is also used as mulching materials in crop land.
3. Outline three ways in which fodder grasses are important.
   (i) They make the bulk of food for livestock.
   (ii) They are used as stakes for climbing crops.
   (iii) They help maintain soil fertility.
   (iv) They prevent soil erosion hence are important in soil conservation.
4. Distinguish between a runner and a stolon in fodder grasses.

A runner is a slender stem that originates from a leaf axil and grows along the ground or downwards producing a new plant at its tip. While a stolon is a horizontal, fleshy stem that can root and then produce new shoots from the rooted region.

5. Make a fully labelled diagram of a napier stem cutting:

Napier stem cutting

4.13 Structure of every lesson

Lesson 1: Some fodder grasses cultivated in Rwanda

Learning objectives:

(a) Knowledge and understanding:
   (i) Define the fodder grasses.

(b) Skills:
   (i) Perceive the fodder grasses grown in school.

(c) Attitudes and values:
   (i) Agree with the colleagues to the folder grasses cultivated in Rwanda.

Prerequisites/Revision/Introduction

Teacher introduces the lesson by asking learners to outline different types of crops/ plants cultivated in Rwanda that they know.

Teaching Aids

- Computers connected to the wireless internet.
- Library books

- Pens
- Note books
- Coloured pictures of fodder grasses.

Learning Activities

Research and discussion

The teacher to divide the learners in groups and instruct them to find out the definition of grasses. The teacher also provides references. The learners to give their opinion, discuss and present their findings to the class and then take summary notes from the teacher.

Synthesis

Teacher guides learners to summarise their findings on some fodder grasses cultivated in Rwanda (Pages 185 - 193 of Student's Book).

Assessment

Explain what a temporary fodder grasses are:

Answer: Temporary fodder grasses are cultivated or grown intensively like other crops. They are grown for one or two seasons and then replaced.

Answers

Exercise 4.1 (page 192 of Student's Book).
Fodder grasses grown for fodder only.
B – Brachiaria grass
D – Guatemara grass
E – Napier grass
Fodder grasses grown that are multipurpose.
A – Maize
C – Pearl millet
F – Oats

Lesson 2: Importance of fodder grasses

Learning objectives:

(a) Knowledge and understanding:
  (i) Discuss the importance of the fodder grasses
(b) Skills:
  (i) Recognise the importance of fodder grasses grown in Rwanda
(c) Attitudes and values:
  (i) Appraise the importance of folder grasses.

Prerequisites/Revision/Introduction

Teacher to introduce the lesson by asking learners questions about the definition of the fodder grass and some examples of fodder grasses to review the previous lesson.

Teaching Aids

- Computers connected to the internet.
- Library books or textbooks.
- Pens
- Note books
- Questionnaires

Learning Activities

Research and discussion

The teacher to divide the learners in groups, provide reference materials and instruct learners to find out the importance of fodder grasses. Learners to find out information, discuss and present their findings. The teacher to conclude by making any corrections and pro- vide summary notes.

Synthesis

The teacher guides learners to summarise the lesson on importance of fodder grasses (page 193 - 207 of Student's Book).

Assessment

Explain the ways in which fodder grasses are important.

Answer

(i) They provide livestock feeds.
(ii) They are used as stakes for climbing crops.
(iii) They help maintain soil fertility.
(iv) They control soil erosion.

Lesson 3: Propagation methods of fodder grasses

Learning objectives:

(a) Knowledge and understanding:
    (i) Explain the propagation methods of fodder grass
(b) Skills:
    (i) Stand for propagation methods of fodder grasses
(c) Attitudes and values:
    (i) Take care while searching the methods of propagation of fodder grasses

Prerequisites/Revision/Introduction

Teacher asks learners the questions on the importance of fodder grasses to review the previous lesson.

Teaching Aids

- Computers connected to internet
- Library books
- Textbooks
- Pens
- Note books

Learning Activities

Research and discussion

The teacher to divide learners, provide reference materials and instruct learners to discuss propagation methods of fodder grasses. Learners to give their opinion, record and present their findings and take summary notes. The teacher to correct any misinformation.

Synthesis

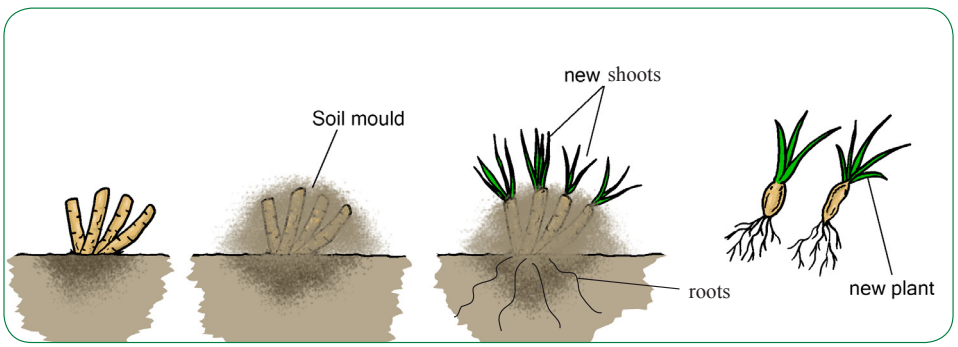
Teacher guides learners to summarise the lesson on propagation methods of fodder grasses (page 207 - 214 of Student's Book).

Assessment

Describe different methods of layering fodder grasses through drawing.

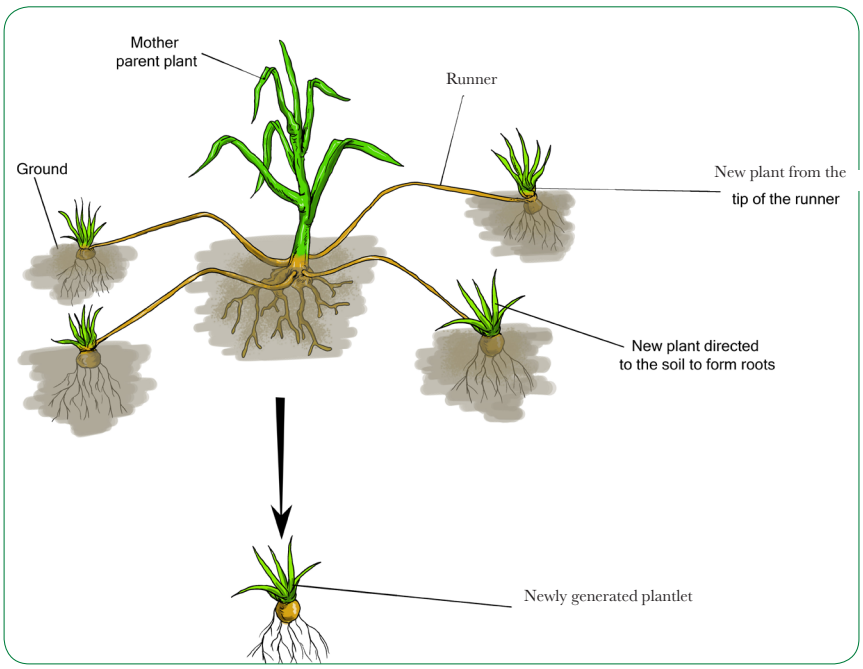
Answer

Stool/mound layering

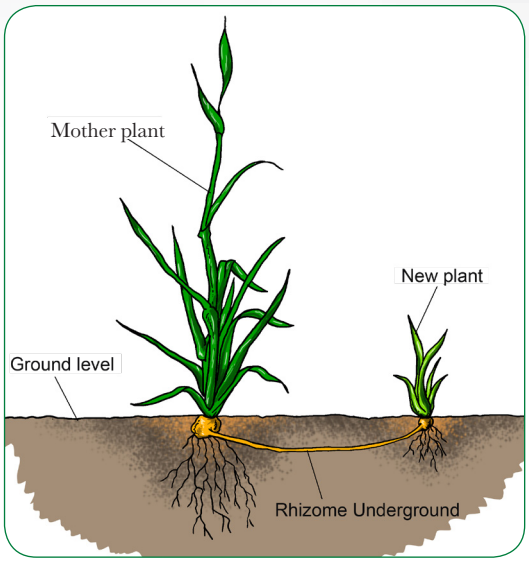


Compound layering on stolons, runners and rhizomes stolons.

Use of runners



Use of rhizomes



Lesson 4: Traditional practices of fodder grasses (Napier grass, Guatemala grass, Brachiaria grass and Para grass)

Learning objectives

(a) Knowledge and understanding:
Explain the Traditional practices done on fodder grass.

(b) Skills:
Conduct fodder grasses cultivation.

(c) Attitudes and values:
Be careful when conducting traditional activities.

Prerequisites/Revision/Introduction

Teacher introduces the lesson by asking learners the questions on propagation methods of fodder grasses to review the previous lesson.

Teaching Aids

- Prepared land
- Hand hoe
- Garden line

- Cuttings of fodder grasses
- Guatemala stem cuttings/runners/splits.
- Tape measure
- NPK and TSP fertiliser
- Wheel barrow
- Farmyard measure
- Animal slurry
- Machete

Learning Activities

Field visit or field attachment combined with practical activity

Teacher to instruct the learners to carry out cultural practices in growing Napier grass, supervise the learners and assist where need be. Learners to carry out cultural practices, discuss and present their findings and take teacher's summary notes.

Teacher to instruct learners to carry out cultural practices in Guatemala and Brachiaria grass. Learners discuss their experience, record and present their findings to the class. The teacher to summarise and give summary notes.

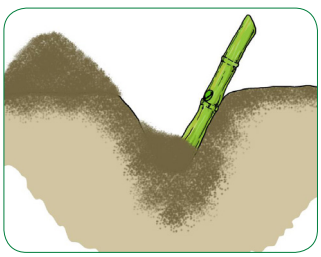
Synthesis

Through demonstration, the teacher consolidates the practicals on traditional practises of Napier grass, Guatemala grass, Brachiaria grass and Para grass (pages 215 – 220 of Student's book).

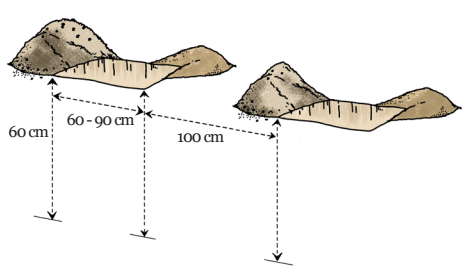
Assessment

1. Describe the procedures of planting napier grass (Tumbukiza method of planting)

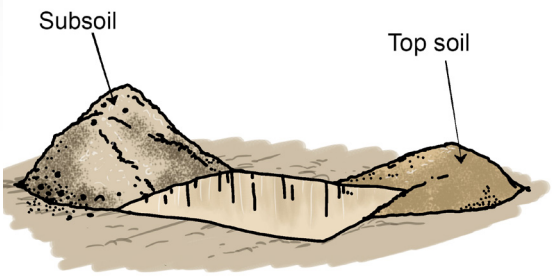
Answer



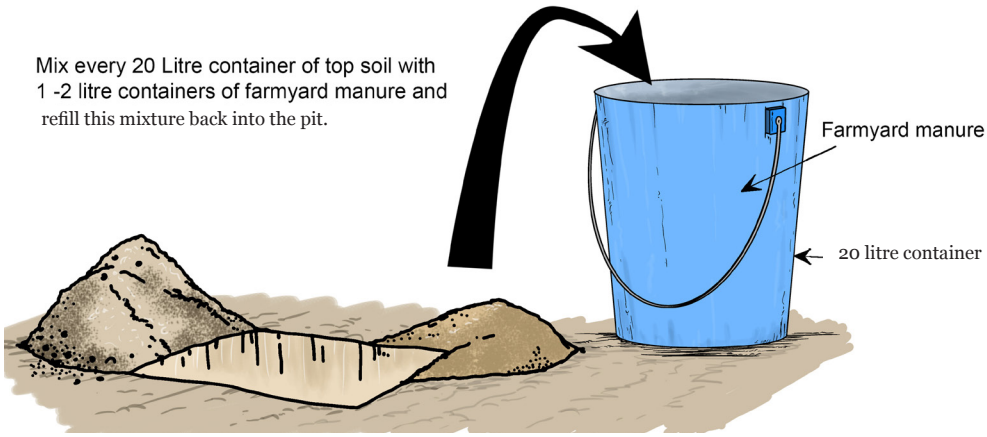
Dig a round or rectangular hole known as pits of 60 cm deep, 60 - 90 cm wide and any length required. The pits should be 100 cm away from each other.



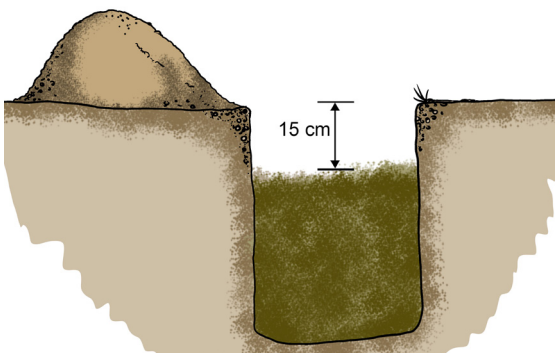
Separate the top and the subsoil when digging the pits.



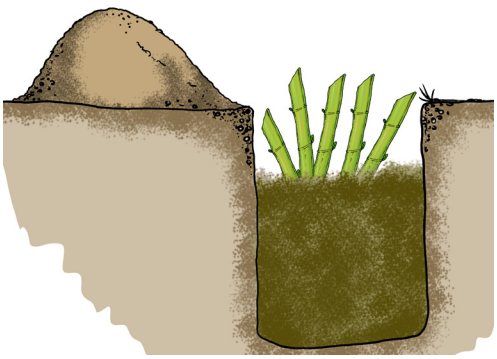
Mix every 20 Litre container of top soil with 1 -2 litre containers of farmyard manure and refill this mixture back into the pit.



Leave a space of about 15 cm unfilled from the top to each pit.



Plant 5 - 10 cane cuttings on single root splits in the pit



2. Explain to the farmer all the requirements and techniques used for harvesting Guatemala grass

Answer

Guatemala grass is first cut when it is 4–6 months old. It is fed as green fodder or

used to make hay or silage. If harvested for direct feeding, Guatemala should be cut when it reaches 100 cm – 120 cm high at about 10 cm – 25 cm from the ground level. The grass does not withstand heavy grazing or frequent cutting. Cutting (defoliation) frequency should be after about 30 days in wet seasons and 42–45 days in dry seasons. If it is for silage making, then it should be wilted before ensiling. It has high ability to remain leafy for a long time.

Lesson 5: Traditional practices of fodder grasses (fodder maize, Sorghum, fodder Oats and Pearl or Bulrush millet)

Learning objectives:

(a) Knowledge and understanding
Express the traditional practice done on fodder grasses

(b) Skills
Conduct fodder grasses cultivation

(c) Attitudes and values
Be careful when conducting traditional activities

Prerequisites/Revision/Introduction

Teacher asks learners to identify cultural practices of Napier grass,Guatemala grass, Brachiaria grass and Para grass to review the previous lesson.

Teaching Aids

- A prepared piece of land.
- Maize seeds, pearl or bulrush millet seeds and oat seeds
- Colombus grass and Sudan grass seeds.
- Phosphotic fertizers
- Garden line
- Tape measure
- Hand hoe
- Wheel barrow
- Calcium Ammonium Nitrate (CAN) and Ammonium Sulphate Nitrate (ASN)
- Oats and pearly (treated) seeds
- Machete

Learning Activities

Supervised activity

Teacher to instruct learners to carry out cultural practices in growing fodder maize and sorghum and supervise the learners. Learners to discuss their experiences, record and present their finding and then take teacher's summary notes.

The teacher to instruct and supervise learners carrying out cultural practices in growing fodder oats and millet. Learners to discuss their finding and record, then present them to class. Teacher to give summary note

Synthesis

Through demonstration, the teacher to consolidates the findings of learners on traditional practises of fodder maize and Sorghum and fodder Oats and Pearl or Butrush millet (pages 221 – 225 of Student's book).

Assessment

Explain to a farmer the process of carrying out weeding in both fodder maize and sorghum fields.

Answer

Fodder maize is harvested at the dough stage or at milk stage, when the crop has high crude protein about 9.8% and crude fibre. Fodder maize makes high quality silage and also supplies green fodder which has no toxic effect to livestock. Fodder maize can be harvested manually by cutting with machetes or mechanically using forage harvesters incase it is for silage making. The harvested fodder is cut and chopped into small pieces ready for ensiling.

The first harvesting should be done when the grain reach early or late dough stage, then cut every 6–8 weeks interval and should be ploughed off after 5–6 cuttings because they become uneconomical to keep. They should not be cut earlier than 6 weeks to avoid prussic acid poisoning.

Unit 5 Fish farming and bees keeping

5.0 Key Unit Competence

Learners should be able to recognise fish species by their characteristics and make successful beehive.

5.1 Prerequisite knowledge and skills

Learners should have knowledge and practical skills in animal production such as selection and breeding, feeding, parasite and disease control, housing and obtaining livestock products from the animals.

5.2 Cross-cutting issues to be integrated in the teaching and learning activities

The following are the emerging issues addressed by this unit:

(i) **Gender:** When working together both boys and girls in construction of top-bar hive and stocking bee hive, the learners appreciate the need to treat every individual equally.

(ii) **Standardisation culture:** The activities that learners carry out in this unit especially in lesson 4 where they construct a top bar hive should be done accurately to standards by respecting the dimensions.

(iii) **Inclusive education:** All learners will be engaged in activities of their own abilities in soil erosion control. Learners with special needs will be integrated into activities which they can manage such as collecting of trash and arranging of stones. This brings on board every individual regardless of special needs ability and gender.

5.3 Generic competences:

- **Critical thinking and problem solving skills** – The problem stated on the page 234 of Student's Book will help learners to think broadly to find solutions on problems of bees hanging on tree branches and on roofs of houses
- **Research** – This will help learners to find answers to questions based on existing information through research on internet and reading books as indicated in many activities of this unit.

- **Communication in official languages** – Teachers, irrespective of being language teachers, will ensure the proper use of the language of instruction by learners. The teacher should communicate clearly and confidently and convey ideas effectively through spoken and written modes by applying appropriate language and relevant vocabulary.
- **Co-operation, inter personal management and life skills** – This will help the learners to co-operate as a team in whatever task assigned especially discussions as indicated in activities of this unit to practise positive ethical moral values while respecting rights, feelings and views of others.

5.4 Key terms

1. **Monoculture:** An agricultural practice of rearing a single species of livestock.
2. **Polyculture:** An agricultural practice of rearing more than one species of animal at the same time.
3. **Cannibalism:** It is the eating of the flesh of another animal of its own kind.
4. **Concave:** Having an outline or a surface that curves inwards.
5. **Aquaculture:** Rearing of aquatic animals such as fish.
6. **Aquaponics:** A system that combines the raising of aquatic organisms and growing of plants in the same water.
7. **Plankton:** Microscopic organisms that live in the water and provide food for other organisms.
8. **Macrophytes:** An aquatic plant which can be seen with the naked eyes.
9. **Herbivorous:** Feeding on the plants.
10. **Palatable:** Pleasant or agreeable taste.
11. **Pollution:** The transfer of pollen grains from the anthers to the stigma.
12. **Forage plants:** These are flowering plants from which bees collet nectar, pollen, gums and resins.
13. **Nectar:** A sugary fluid secreted by plants in the flowers collected by bees to make honey.
14. **Pollen:** Fine powdery substance produced by the anthers in the flower and collected by bees as feed for the young ones.

15. **Pheromone:** A chemical substance produced by the insect for example the queen bee that affect the behaviour of others of its species named after.
16. **Longstroth:** A hive that is named after Lorenzo Lorarine Langstroth who invented it and designed it.
17. **Castes:** A system dividing organisms into classes or social groups.
18. **Resins:** A sticky organic exudates from certain trees and plants such as cider, fir and pines.
19. **Turnover to capital:** The rate at which an investment is able to bring back money invested and profit.
20. **Benthic fauna:** The community of organisms that live on or in the bottom of a water body.
21. **Gums:** A viscous secretion of some trees and shrubs that harden or dry but soluble in water.
22. **Omnivorous:** An organism that feeds on both plants and animals.
23. **Sub-terminal:** Situated or occurring near but precisely at the end.
24. **Barbells:** A slender external whisker like tactile organ on the jaw or other part of the head of certain fishes.
25. **Detritus feeder** or **detritus eater:** Is an organism such as bacterium fungus or insects that feed on dead plant or animal matter.

5.5 Problem statement: Guidance to the teacher

(a) Divide the learners into groups and instruct them to observe and study the photographs given in Student's Book page 232 – 233.

(b) Assist them to analyse the photographs and then in answering the questions as follows:

(i) What is happening in these photographs?

The answer is being as follows:

- Photograph 1 – A swarm of bees on a tree.
- Photograph 2 – A swarm of bees on a house.
- Photograph 3 – (a) Bees in a traditional log hive.

(c) Bees in a modern top bar hive.

- Photograph 4 – Fishes in an aquarium.
- Photograph 5 – Fishes in a pond.
- Photograph 6 – Fishes in a river.

(ii) What can be done on photograph 1 and 2 to solve the problem?

Answer

Use a swarm net or a catcher box to catch the bees from the tree or house tops to stock the hive.

(c) Assist the learners to analyse the three methods of fish keeping and to point out the differences in them as follows:

- Photograph 4 – shows fish keeping in an aquarium.
- Photograph 5 – fish keeping in an artificial pond.
- Photograph 6 – Natural fish in a river.

(d) Help the learners to point out the difference between keeping fish in an aquarium and in the river as follows:

- An aquarium is used to keep ornamental fish for aesthetic purposes whereas a fish pond is used to grow and manage fish to a large scale for consumption or sale.

In photograph 6 fish breed and grow naturally in the river where people can fish them without looking after them. This means that you can only fish the types in the river but not the types you want.

(e) Assist the learners to identify the criteria taken into account when selecting any one of the methods of keeping fish shown in the diagram:

The criteria of selecting methods of fish keeping include:

(i) Types or species of fish required
(ii) Reasons for keeping fish, whether commercial, for food or for aesthetic value
(iii) Capital availability
(iv) Water availability especially for pond fish
(v) Type of soil especially for the pond fish

(f) Allow the groups to present the findings to the class.

5.6 Suggestions for accommodating Special Education Needs (SEN)

Learners with specials needs should be identified and integrated into the learning process just like the others. The following are suggestions for support that can be given to these learners:

Type of special needs	**Support for the learners**
Sensory impairment (hearing)	Ask the learners to sit close to the teacher. Speak loudly so that all learners can hear. Seek for the learners' attention.
Sensory impairment (visual)	Use large prints in questionnaires, practical sheets and examination papers. Provide enough space for the braille machines for those using them. Pair them with the sighted.

Physical impairment (motor)	Conduct activities in one place to avoid constant movement. Provide enough space in class for the wheelchairs in case they use them. Assign them to others.
Gifted or talented learners	Assign them special tasks such as collecting and distributing materials for practicals. Can be asked to prepare and present their findings on behalf of the groups. Paired with special needs learners to assist them.
Slow learners	Given more time to complete the tasks. Assisted in performing their tasks. Attached to talented learners for assistance.

5.7 List of lessons

Lesson No.	Number of Periods	Weeks	Lesson Title
1	1	1st week	Fish species
2	1	1st week	Selection criteria suitable for fish species to rear
3	1	2nd week	Definition of beekeeping and importance of beekeeping
4	1	2nd week	Category of bees and making of beehive (materials and process)
5	2	3rd week	Making of bee hive (materials and process) cont'd Management of bee hive
6	2	4th week	Management of bee hive and harvesting of bee honey (Cont'd) End of unit assessment

5.8 Unit Summary

Aquaculture is the art and science of rearing fish in artificial ponds. It is a growing business in Rwanda because of the need to provide affordable animal proteins in human diet. Fish are reared in combination with other animals such as chicken, pigs and other small animals to reduce the cost of production.

However, monoculture in fish production is also used. The common species of fish reared include *Limnothrissa miodon, Clarias spp, tilapia, Limnothrissa haplochromi*s and *Carp spp*. However, there are other fish species that are also becoming important.

These fish species can be distinguished through their anatomical characteristics. When rearing fish in ponds, proper selection of suitable species is important. Other criteria to consider include adaptability to undrainable pond environment and of most important, have fast growth rate with easy breeding.

Bee-keeping is as important as keeping other livestock. The turnover to capital invested is easy and fast. They provide food, medicine, income, employment and cater for cultural practices. Bees are easy to keep especially where the environment is suitable and with the correct equipment.

Some of the equipment required for bee-keeping include the hive. Most types of hives are cheap and easy to construct, use and maintain. When a bee-keeper is able to differentiate between the three castes of bees, the management becomes easy.

Honey harvesting is a skill that require knowledge of the bee behaviour, otherwise bees produce honey with minimum effort from the farmer, all you have to do is provide conducive environment and feed them during the periods of scarcity.

5.9 Additional information for the teacher

Materials collected by bees

(i) **Nectar** – This is the sweet sugary juice collected by the honey bee from the flowers. It is used as the bee's main food and in making honey. The worker bees swallow it in their stomach and once it is acted upon by enzymes, it is regulated back to the mouth and deposited into the cells of the comb as honey.

(ii) **Pollen** – Pollen from flowers is collected in special pollen baskets found on the hind legs of the worker bees. It contains 30% proteins and used to feed the brood. Human beings use it as spices and eat it.
(iii) **Propolis** – This is a bee product which is collected from trees. It is made up of tree resins and gums and is used by the bees to seal all cracks in the hive. When extracted from the hive it is blackish and spongy and has medicinal effects.
(iv) **Water** – This is essential for the survival of bees. Bees collect water from nearby rivers, swarms and other water bodies. If these sources of water are far, bees get water from taps and drains of residential areas.

Swarming of bees

This is a natural way of which honey bee colonies multiply or reproduce. The increase in bee population in the hives causes overcrowding causing the worker bees to raise another queen in preparation to divide the colony. Swarming usually takes place after flowering seasons. It is uneconomical for the bee keeper to lose a colony.

Causes of swarming

(i) Overcrowding – When the numbers are too high, they cause uncomfortable condition in the hive.
(ii) Hereditary traits – Certain bees have inherited tendency to swarm.

Control measures of swarming

(i) The bee keeper should divide the colony to reduce overcrowding.
(ii) Introduce a queen with fewer tendencies to swarm.

5.10 Suggested answers to end of unit 5 assessment (pages 278 – 279 of Students' Book)

1. (i) Bees are kept as a source of food.
   (ii) Source of medicine.
   (iii) For cultural purposes.
   (iv) As a source of income generation.
   (v) Source of employment.
   (vi) Source of bees wax.
   (vii) For pollination in crops.
   (viii) As a conservation of natural resources.
   (ix) As a cheap occupation.
   (x) From Api-tourism and scientific research.
   (xi) As a hobby.

2.

Queen bee	**Worker bee**
(i) Has elongated body	Small body
(ii) Small eyes	Medium sized body
(iii) Rounded and small head	Triangular head
(vi) Wings do not cover the whole abdomen	Wings cover the whole length of the body
(v) Smooth and curved sting	Straight and barbed sting
(vi) Only one in the hive	Thousands in number in the hive

3. Good quality honey should:
   (i) Be viscous – give a continuous flow
   (ii) Sweet tasting without the taste of smoke
   (iii) Be clean
   (iv) Have the right moisture content
4. (a) (i) Ants
   (ii) Wax moths
   (iii) Bee louse
   (iv) Pirate wasp
   (v) Beetles
   (b) Control measures of the insect pests
   (i) Grease the hanging posts and the wires/use physical bar.
   (ii) Smoke the hive to control bee louse.
   (iii) Clear the vegetation around the apiary.
   (iv) Identify and destroy the nests of the wasps.
5. (i) Avoid excessive smoking, this might kill the brood and lower the quality of honey.
   (ii) Use protective clothing– The whole body should be protected from bee stings.
   (iii) Protect the hive from the rain and hot sun– This is done by building a shed above the hive.
   (iv) Use clean equipment and containers to avoid contaminating the honey.
   (v) Avoid harvesting all the honey from the hive – This may make the bees to abscond the hive due to luck of food.
6. (i) Clarias fish have long– based darsal and anal fins which give them eel-like appearance.
   (ii) They have slender bodies
   (iii) They have a flat bony head
   (iv) They have a broad terminal mouth with four pairs of barbels.

(v) They have large accessory breathing organs composed of modified gill arches.
(vi) Only the pectrol fins have spines.

7. (a) A — Wooden post
   (b) B — Suspending wire
   (c) C — Top Bar Hive
   (d) D — Wooden platform

   (e) To control pests such as honey badger, monkeys and insects.

8. (i) Collect all the tools and equipment needed
   (ii) Wear the protective clothing.
   (iii) Light the smoker.
   (iv) Approach the hive quietly from the back/sides.
   (v) Puff smoke through the entrance and sides.
   (vi) Open the hive and inspect the combs by lifting the top bars.
   (vii) Brush the bees from the completely capped combs and cut it.
   (viii) Place the cut comb into a covered container.
   (ix) Return the top bar and cover the hive.
   (x) Place the hive back to its normal position
   (xi) Clean any broken combs from the area and leave.
9. (a) Smoker
   (b) Used to puff smoke to the bees in order to make them docile.

5.11 Remedial Activities for slow learners

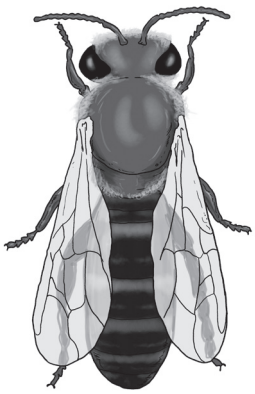
1. List four products from honey bees.
   (i) Honey
   (ii) Bees wax
   (iii) Propolis
   (iv) Nectar
   (v) Pollen
2. Mention four distinguishing characteristics of the tilapia:
   (i) It is a bony fish
   (ii) It has streamlined body
   (iii) It is covered with scales throughout the body
   (iv) The body is divided into head, trunk and tail.
3. List three categories of bees that make up a bee colony:
   (i) Queen bee
   (ii) Worker bee
   (iii) Drones

4. State four functions of a worker bee in a hive:
   (i) Protect the hive
   (ii) Feed the Queen and the brood
   (iii) Collect nectar/food
   (iv) Collect water
   (v) Clean the hive
   (vi) Build the combs
   (vii) Prepare for a new queen
5. Which fish is referred to us trash fish? Give reasons.
   Carps fish
   Reason – They are said to be unattractive and slimy and also live in the humid of blackish water.

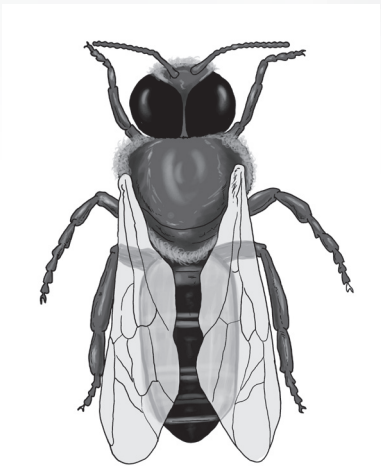
5.12 Extension activities for gifted and talented learners

1. Give four anatomical characteristics of the mouth of the carp fish that distinguishes it from other fish.
   (i) Mouth is sub-terminal with two barbels on each side.
   (ii) It has no teeth.
   (iii) Shorter barbels are found at the tip of the snout.
   (iv) Longer barbels at the corners of the mouth.
2. The figures below show different castes or categories of honey bees in a colony. Study them carefully and then answer the questions that follow.

A



B



C

(a) Identify each of the bee category represented by A, B and C in the diagram.
(i) A – Queen bee
(ii) B – Worker bee
(iii) C – Drone

(b) How many of each category of the above identified bees are found in a colony?
(i) A/ Queen bee= 01
(ii) B/ Worker bees= 60, 000
(ii) C/ Drones = 100 – 150

(c) State the type of food given to each category of honey bees.
(i) A/ Queen bee – feeds on the royal jelly
(ii) B/ worker bee – honey
(ii) C/Drones – A mixture of honey, royal jelly and pollen

3. State two functions of the queen bee in the hive.
(i) To produce fertile eggs/lay eggs.
(ii) Keep the colony together.
4. Name two types of removable comb hives
(i) Top bar hive
(ii) Langstroth hive.
5. Analyse the characteristics of a good site for apiary.
An apiary should:
(i) Have farage of flowering plants near.
(ii) Be close to a water source.
(iii) Be well sheltered from strong wind and sunlight.
(iv) Be in a quiet place without any disturbance.
(v) Be away from human beings and livestock.
(vi) A place without bad odours.

5.13 Structure of every lesson

Lesson 1: Fish species

Learning objectives:

(a) Knowledge and understanding:
  (i) Explain the characteristics of fish species
  (ii) Describe the difference between fish species

(b) Skills:
Find out the fish species with comparison to their anatomic characteristics.

(c) Attitudes and values:
  (i) Observe attentively the fish species and their characteristics.
  (ii) Participate actively in group discussion and interact positively with the colleagues.

Prerequisites/Revision/Introduction

Teachers asks Questions to learners on kinds of animals reared in Rwanda to test what they know on animals.

- Outline any five animals reared in Rwanda that you know of.

Teaching Aids

- Pictures of different fish species
- Computers connected to the wireless internet
- Library books
- Pens
- Note books

Learning Activities
Supervised activity

The teacher to instruct the learners to observe and identify fish species provided using their anatomical characteristics, supervise and assist the learners. Learners to discuss and present their findings and present them to the class. Teacher to give conclusion and summary notes.

Synthesis

Teacher guides learners to summarise the lesson on fish species (page 234 – 241 of Student's Book).

Assessment

1. Mention four fish species reared in artificial ponds.

Answer

(i) Limnothrissa miodon.
(ii) Clarias
(iii) Tilapia
(iv) Limnothrissa haplochromis
(v) Carps

2. Compare anatomical characteristics of clarias and tilapia.

Anatomical characteristics of Clarias

(i) Clarias are recognised by their long-based dorsal and anal fins which give them an eel-like appearance.
(ii) They have slender bodies, a flat bony head and a broad terminal mouth with four pairs of barbels.
(iii) They have large accessory breathing organ composed of modified gill arches.
(iv) Only the pectoral fins have spines.

Anatomical characteristics of Tilapia

(i) Tilapia is a bony fish.
(ii) Has streamlined body for easy movement.
(iii) It is covered with scales for protection.
(iv) The body is divided into head, trunk and tail.

Head

- Starts from the tip of the mouth to the end of the operculum.
- The upper and lower jaws bound the terminal mouth.
- Have teeth.

Trunk

- Starts from the operculum to the anus.
- It bears the fins, pectoral, pelvic which are paired, dorsal fin, ventral and caudal which are used for balancing and swimming.

Tail

- It consists of the rest of the body from the anus to the caudal fin.

Gills

- These are for respiration.
- There is one on either side of the head.
- Each gill is a red comb-like structure supported on a curved bony bar called gill arch.
- Each gill has two slender structures called gill filament.

Lesson 2: Selection criteria suitable for fish species to rear

Learning objectives:

(a) Knowledge and understanding:
State the characteristics of fish species and breeds to rear
(b) Skills:
Select fish species to rear
(c) Attitudes and values:
Be alternative in choosing the fish species and breeds to rear

Prerequisites/Revision/Introduction
Teacher to ask learners to recall species of fishes to review the previous lesson.

Teaching Aids
- Computers connected to the internet
- Library books or textbooks
- Pens
- Note books
- Questionnaires

Learning Activities

Discussion
The teacher to divide learners into groups to provide reference materials and instruct the learners to discuss selection criteria of fish species to rear. Learners give their opinion, record and present their findings to class. The teacher concludes and gives summary notes.

Synthesis
Teacher consolidates the findings of learners on selection criteria of suitable fish species to rear as a summary of lesson (pages 242 – 243 of Student's Book)

Assessment

Explain the characteristics of limnotrissa miodon fish.

Answer

Fairly slender body.
(ii) Its maxilla blade is over four times as long as its shaft.
(iii) The lower gills rakers are longer and slender.
(iv) It has a distinct silver stripe along the flank.
(v) The snout is broad with tapering sides but not concave when viewed from above.
(vi) It has a large air bladder which is responsible for its ability to move greater vertical distances.

Lesson 3: Importance of bee keeping

Learning objectives

(a) Knowledge and understanding:
Define beekeeping and explain its importance

(b) Skills:
Perceive bee hives containing bees and its importance

(c) Attitudes and values:
Agree with colleagues on the definition and importance of bee keeping

Prerequisites/Revision/Introduction

Teacher asks questions to the learners on selection criteria suitable for fish species to rear in order to review the previous lesson.

Teaching Aids

- Text books/library books
- Computers connected to internet
- Pens
- Note books
- Questionnaires

Learning Activities

Research and discussion

The teacher to divide learners into groups, provide reference materials and instruct them to find out the importance of bee keeping. The learners to give their opinions, record and present their findings in class. Teacher to conclude and make summary notes.

Synthesis

Teacher guides the learners to summarise their findings on the importance of bee-keeping (pages 243 – 247 of Student's Book).

Assessment

Is bee keeping important? (If yes, how? If not how?)

Answer

(a) As a source of food – Honey, a product from the honey bees, is a delicious and nutritive food for human. It is eaten whole or mixed with other foods as a supplement. In many communities, it is mixed with simsim and groundnuts.

Bee products such as royal jelly, pollen and brood are also used as proteinous foods. Young brood are given to malnourished children in some societies.

(b) As a source of medicine – Bee products such as bee venom, honey and propolis are used for the treatment of various ailments.
   (i) Bee venom– Used to treat bee poisoning and is therapeutic to Parkinson disease.
   (ii) Propolis – Used to treat and relieve arthritis, asthma, sinusis and others.
   (iii) Honey – Used as an antiseptic on raw wounds and burns, also treats coughs, measles, stomach upsets. Honey has antibiotic properties to kill micro-organisms. It is also used in preservation of meat and other foods.

(c) For cultural purposes– Honey is used to make traditional brews in most communities. This brew has several cultural importance. For example, dowry negotiation ceremonies cannot take place without this brew while honey itself forms part of the dowry.

(d) As a source of income – Honey and other bee products extracted from the hive are sold either locally or exported to generate income for the farmers.

(e) Source of employment – The bee-keeping industry provide employment to a big population including the bee farmers, carpenters who make the hives, value adding, food and beverage industries, pharmaceutical industries and others.

(f) Source of bees wax – This is another bees product which has a lot of value. It is used in cosmetic industries for soap making, pharmaceutical industries to make pill coatings, paint and shoes polish industries.

(g) Pollination – The honey bee is known to pollinate many cultivated and wild plants as it collects nectar, pollen, resins and gums. Crops such as maize, pawpaws, sunflower and others are known to increase their yields in the presence of bees.

(h) Conservation of natural resources – Bee-keeping is an activity that does not lead to the destruction of the environment like crop and livestock farming. Bees need forage plants which include trees for their raw materials they collect. Farmers plant and protect trees, shrubs and other bee plants to provide habitants for the bees.

(i) Bee-keeping is a cheap occupation due to the following reasons:
   - it does not require a lot of land. Land is always a limiting factor to small-scale farmers.
   - it does not require a lot of expenses, for example, in terms of feeding except during drought.
   - the materials needed to start a bee-keeping business are cheap and locally available.
   - raw materials for making honey such as nectar and pollen may be wasted if bees are not kept.
   - they can be profitably kept in the semi-arid and arid areas which may be unsuitable for crop production. This makes such areas productive.

(j) Api-tourism and scientific research bee reserves attract tourists and scientists who carry different scientific research in them.
(k) Hobby – bee-keeping is used by several people as a hobby. It is an enjoyable activity away from the formal type of employment.

Lesson 4: Category of bees and making of bee hives

Learning objectives:

(a) Knowledge and understanding:
  (i) State the categories of bees
  (ii) Explain the process of making a bee hive
(b) Skills:
  (i) Recognise the categories of bees.
  (ii) Make bee hives
(c) Attitudes and values:
  (i) Pay attention while observing the categories of bees.
  (ii) Show concern while making a bee hive.

Prerequisites/Revision/Introduction

Teacher asks learners the questions on the importance of bee-keeping to review the previous lesson.

Teaching Aids

- Note books
- Questionnaire
- Pens
- Internet
- Library books

Learning Activities

Field visit and discussion

The teacher to organise a field visit, prepare a questionnaire, as in Annex 16 and instruct the learners to make observations and categorise bees in a colony. Learners to discuss, record and present their findings. Teacher to conclude and make summary notes.

The teacher to divide learners into groups, provide references and instruct them to discuss beehive making materials. Learners to look for information, record and present their findings in class. Teacher to conclude and make summary notes.

Synthesis

Teacher consolidates the findings of learners on category of bees and making of bee hives (pages 248 – 259 of Students book).

Assessment

Compare and contrast the construction of materials of top bar hive and longstroth hive.

Answer

Construction materials for Top Bar Hive

The following are the construction materials for the top bar hive:

- Sawn timber of about 3 cm thickness. This timber should be smooth and enough to make the side pieces, bottom piece, the end pieces and the top bars.
- 1 sheet of corrugated iron sheet about 3 m wide.
- Plain wire about 5 m long.
- 1 kg, 5 cm nails.
- 6.4 cm nails, 4–5 pieces.

Cider or cypress timber is the best for the construction of the top bar hive.

These materials will be cut to size during the construction of the top bar hive.

Construction materials for longstroth hive

The following are the construction materials for the Langstroth hive:

- Sawn timber of about 3 cm thickness. This should be enough to construct the chambers of the hive as required
- Mesh wire of 4 × 4 mm mesh size, one piece of 60 × 50 cm is required
- Nails or deck screws
- 80 × 40 cm sheet of $\frac{3}{4}$ inch plywood
- 50 mm nails (2 inches nails)
- White or light paint about 5 litres tin
- Timber frames; these can be bought when they are ready made.

2. Categorize bees according to their functions

Functions of the queen bees

The queen bee functions in the hive include:

- To lay eggs: She determines at will when to lay the fertilised eggs which develop into either queen bees or worker bees and unfertilised eggs which develop into drones.
- To keep the colony together: The queen produces a pheromone known as queen substance which keeps the members of the colony together. This substance will guide the worker bees on how to identify the hive when they come back from foraging. It also helps them to identify each other. The queen substance also inhibit ovary development in worker bees. There is only one queen at a time in the colony.

Functions of the worker bees

They carry out all the chores of the hive which include:

- Protection and defending the hive.
- Clean the hive.
- Collect food (nectar, pollen) and water.
- Feed the queen, brood and drones.
- Build the combs.
- Prepare a new queen when need be.
- They determine whether the queen is incapacitated, kill her and prepare for another queen in the queen cells at the edge of the combs.
- Scout for new locations to swarm to.

Functions of the drones

- They mate the queen: They congregate outside the hive and wait for the queen while patrolling the hive. They fly about 9-15 m above the ground to mate.
- They cool the hive: They flap their wide wings at high speed increasing air movement.

Lesson 5: Making of bee hive and management of bee hive

Learning objectives:

(a) Knowledge and understanding:
  (i) Explain the process of making a bee hive.
  (ii) Carry out management of bee hive and harvesting of honey bee.

(b) Skills:
  Practice management activities of bee hive and harvest honey bee.

(c) Attitudes and values:
  (i) Be careful to avoid risks to yourself and others while managing bee hive and harvesting honey bee.

Prerequisites/Revision/Introduction

Teacher asks learners the questions on category of bees and making of bee hives to review the previous lesson.

Teaching Aids

- Cider or cypress timber 3 cm, thickness
- 1 sheet of corrugated iron sheet, 3 m wide
- Plain wire 5 m long
- 1 kg, 5 cm nails
- 6.4 nails about 4–5 in number
- Claw hammer
- Hand saw
- Tenon saw
- Hand drill and bits

Learning Activities

Supervised activity

Teacher to instruct learners on the construction of a Top bar hive, provide material for construction, assist the learners to construct a Top bar hive. Learners to discuss, record and present their finding in class. Teacher to conclude and make summary notes.

Synthesis

Teacher to consolidate the practical activities and discussions of learners on construction of bee hive (pages 257 – 264 of Student's Book).

Assessment

1. What is the advantages of housing the bees between two posts as compared to placing it on the timber platform?

Answer

(i) During drought, to maintain the colony.

(ii) When a new colony has just entered the hive.

2. Describe a procedure for constructing a top bar hive.

Answer

The top bar hive is a movable comb hive. Narrow bars normally of wood rest across the top part of a box-like container and hence the name top bar hive. The box forms the space that contains the bees nest. Bees build combs on the bars which are wide enough to give proper spacing between combs. A bar with its attached comb and adhering bees can be removed from the hive and examined. Each comb is built naturally by the bees, suspended from its top bar. Top bars are the slats of timber on top of the hive to which bees attach their combs. They are placed side by side to completely cover the whole hive container or space. An outer lid or cover is provided over the bars for additional protection from the weather elements.

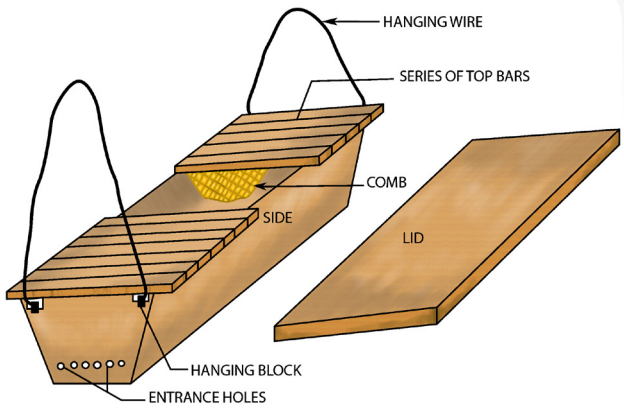
Construction materials

The following are the construction materials for the top bar hive:

- Sawn timber of about 3 cm thickness. This timber should be smooth and enough to make the side pieces, bottom piece, the end pieces and the top bars
- 1 sheet of corrugated iron sheet about 3 m wide
- Plain wire about 5 m long
- 1 kg, 5 cm nails
- 6.4 cm nails, 4–5 pieces

Cider or cypress timber is the best for the construction of the top bar hive. These

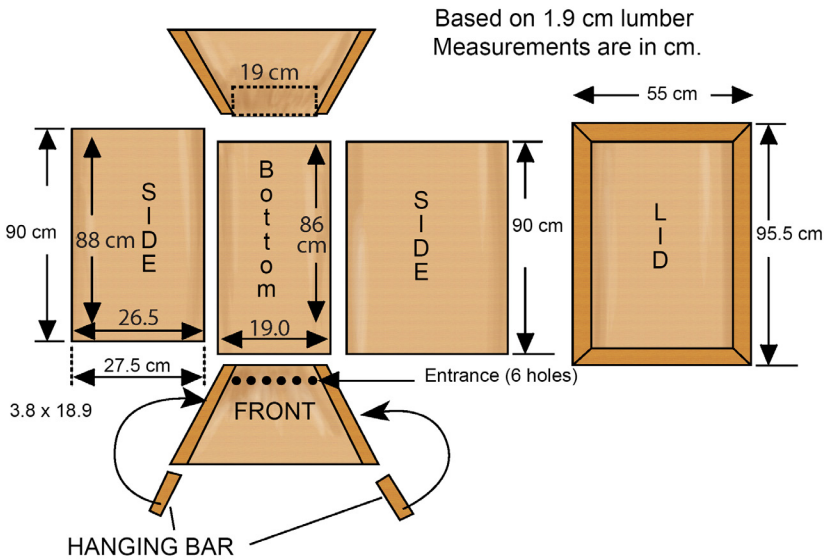
materials will be cut to size during the construction of the top bar hive.



Procedure for constructing a top bar hive

1. Cut the timber into the following pieces:
   - 2 -end pieces each measuring 48.3 × 27.5 × 18.9 cm
   - 2-side pieces each measuring 90.0 × 27.5 cm
   - 1- bottom piece measuring 86.0 × 19.0 cm
   - 27 pieces top bars each measuring 48.3 × 3.2 cm

   The cut pieces are as shown in the following figure (a).

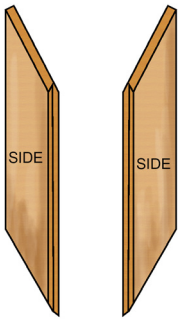


(a)

2. Drill six holes on the narrow end of one of the end pieces.

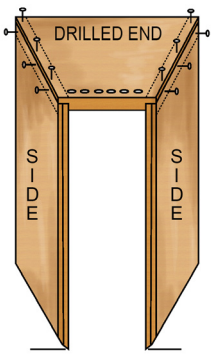
3. Assemble the pieces as follows:

(i) Hold the two side pieces upright as shown in the figure 5.29 (b) below.



(b)

(ii) Place the drilled end of one end piece on top of the side at the bottom end of the two side pieces. The drilled edge of the end piece should be at the slope cut of the side pieces as shown in the following figure (c). Fix the edges together with the 5 cm nails.

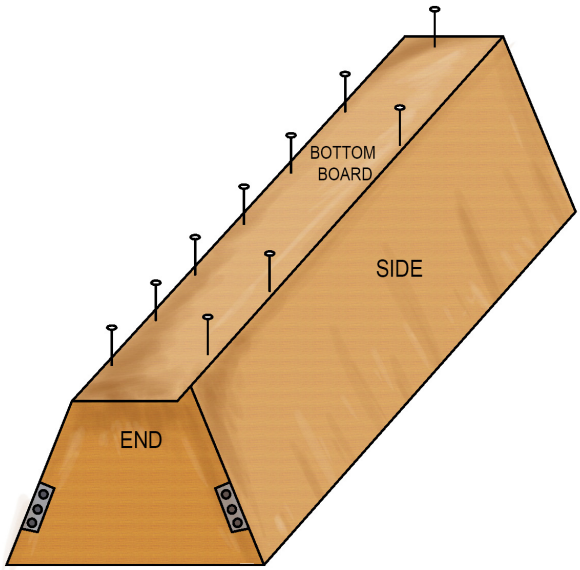


(c)

(iii) Repeat this procedure for the other end piece which does not have holes on it. Fix it in place firmly with the 5 cm nails.

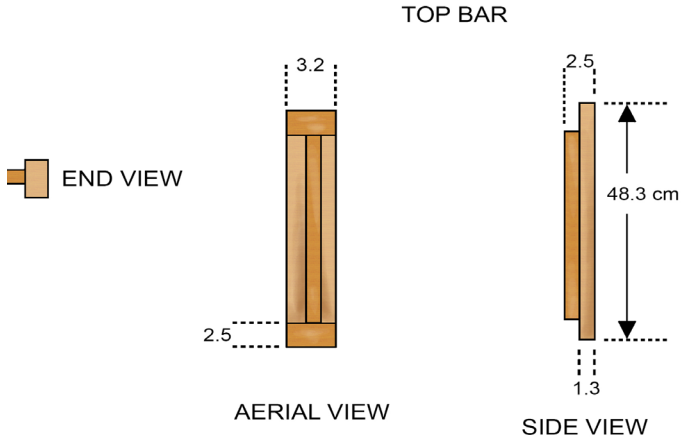
(iv) Now turn the whole structure upside down so that the narrow side faces upright. Fix the bottom piece on top firmly with the 5 cm nails, all round. Attach the hanging blocks on the end pieces on both ends, using the 6.4 cm nails. This is shown in figure below.

The hanging blocks should be nailed at the position where they will not interfere with the lid.



(d)

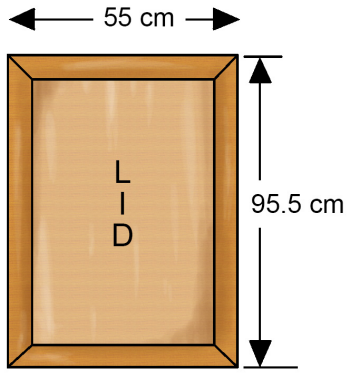
4. Prepare the top bars by chiseling both sides of the top bars to leave a protruding strip of wood where the starter wax is applied. This is shown in the following figure



(e)

5. Construct the top cover as follows:
   (i) Cut a piece of corrugated iron sheet measuring 100.5 × 60 cm using a pair of tinsnip.

(ii) Fold and nail about 5 cm length of the iron sheet round a timber frame to make the safety edges of the top lid or cover. The final dimensions of the top lid should be 95.5 × 55 cm with a safety edge.



(f)

Lesson 6: Management of bee hive and harvesting of honey bee
Learning objectives:

(a) Knowledge and understanding:
Carry out the management of bee hive and harvesting of honey bee

(b) Skills:
Practice management activities of bee hive and harvesting honey bee

(c) Attitudes and values:
Be careful and avoid risks to yourself and others while managing bee hive and harvesting honey.

Prerequisites/Revision/Introduction

Teacher to provide photos of enemies of honey bee and ask learners how to manage them to review the previous lesson.

Teaching Aids

- A questionnaire
- Smoker
- Wood ash
- Queen excluder
- An apiary
- Pan
- Apiary with beehives
- Protective clothing
- Smoker
- Sugar syrup
- Protective kit
- Grease
- Top bar hives
- Swarm net
- Note books
- A bucket or container with a lid
- Bee brush
- Hive tool

Learning Activities

Field visit/supervised activity

The teacher to organise a field visit, prepare a questionnaire as in Annex 17 and instruct the learners to observe beehive and carry out beehive management. Learners to carry out beehive management, discuss, record and present their findings in class. Teacher to conclude and make summary notes.

The teacher to organise for a field visit, prepare a questionnaire as in Annex 18 and instruct the learners to observe and carry out honey harvesting. Learners to discuss, record and present their findings in class. Teacher to conclude and make summary notes.

Synthesis

Through demonstration the teacher to consolidate the findings of learners on the management of bee hive and harvesting of honey (pages 265 – 276 of Student's Book).

Assessment

1. Carry out the maintenance practises required in an apiary:
   (i) Clearing the vegetation.
   (ii) Replacing broken posts and platforms.
   (iii) Avoid use of pesticides around.
   (iv) Cleaning and removing all broken pieces of combs after harvesting.

2. You are in an apiary that has a problem of enemies. Show the farmers how they will control insect pests in their own apiaries

   (i) Insects include wax moths, beetles, safari ants, sugar ants, termites, bee louse and pirate wasps.
   Insect pests are generally controlled by:
   - Maintaining a strong colony through proper feeding during drought.
   - Removing destroyed combs.
   - Fumigation with ethylene dibromine to control moths.
   - Reduce the bee entrance space to prevent entry of beetles.
   - Greasing the hanging wires and posts to create barriers for the ants.
   - Clearing the bushes around the hives.
   - Use of tobacco smoke to dislodge the lice from the bees.
   - Use of wasp traps to prevent the robber bees.
   - Avoid leaving pieces of honey combs outside the hive .

   (ii) Mammals that predate on the honey bees, eat the honey, the brood and destroy the hives. they include human beings, honey badger, monkeys and squirrels.
   These predators are controlled by:
   - Suspending the hive by use of wires.

- Proper and securely fencing the apiary.
- Use of bee house.
- Scaring and surveillance.
- Setting traps.

(iii) Amphibians include frogs and toads. They feed on the bees. They are controlled by making sure that the apiary is not set in marshy areas.

(iv) Birds include the honey guide and the European bee eater bird.
They feed on the bees, the brood and the honey. They are controlled by scaring.

Unit 6 Animals (pigs and poultry)

6.0 Key Unit Competence

Learners should be able to successfully conduct rearing of poultry and pigs.

6.1 Prerequisite knowledge and skills

Learners should have knowledge and practical skills in animal production such as selection and breeding, feeding, housing, parasite and disease control and obtaining livestock products from the animals.

6.2 Cross-cutting issues to be integrated in the teaching and learning activities

The following are emerging issues addressed by this unit:

(i) **Gender:** Both boys and girls take part in construction of animal structure, feeding and maintaining health in the farm. This enables them understand the importance of gender equality.

(ii) **Peace and values education:** When focusing on the contribution to the construction of pig and poultry structures, the learners recognise the importance of working in harmony and peace to avoid conflict that may come from misuse of materials like nails and hammer that may injure their colleagues.

(iii) **Standardisation culture:** Learners are able to maintain standards in feeding poultry and pigs and keeping them healthy. This helps them to understand that keeping standards is an economic pillar towards development and sustainable future.

(iv) **Inclusive education:** Inclusive practicals in this unit helps learners to welcome and appreciate each other regardless of their gender ability including those with learning difficulties so that all can benefit.

6.3 Generic competences

- **Critical thinking and problem solving skills** – The acquisition of such skills will help learners to think critically and deeply while analysing the problem of people who live together with livestock and find solutions to that problem and others encountered in our surrounding.
- **Research** – This will help learners to find answers to questions based on existing information through internet and reading library books as indicated in some activities within a unit.

6.4 Key terms

1. **Mash:** A mixture of food ingredients in meal farm.
2. **Meal:** Ingredient(s) that has been ground or reduced to particle size larger than flour.
3. **Pellets:** Agglomerated feed formed by compaction or feed compacted to form different shapes.
4. **Ration:** The total amount of feed (diet) allocated to one animal for a 24-hour period.
5. **Roughages:** Plant material high and crude fibre but low in digestibility and low in protein.
6. **Starch grain:** Whole cracked or coarsely cut grain.
7. **Supplement:** A feed used with another to improve nutritive value.
8. **Cake:** The mass that results from pressing seeds, meat or fish to remove oils, fats or other liquid.
9. **Casein:** The proteins from skin milk used to make cheese.
10. **Chaff:** Glumen, hulls, joints and small fragments of straw that are separated from seed in threshing or processing.
11. **Dry matter (DM):** Actual percentage of proteins, carbohydrates and minerals in feed.
12. **Draught:** Dry, cold, windy conditions blowing through livestock houses.
13. **Airborne:** Acquired through the air by inhalation.
14. **Slatted floor:** Wooden or metal floor with narrow gaps between slats to allow discharge of droppings.
15. **Systematic:** Starts in one part of body and then spreads to the other organs and systems.
16. **Crude protein (CP):** The sum total of all nitrogenous compounds in a feed.
17. **Offal:** Low grade residue left from the milling of some products.
18. **Shelter belt:** A line of trees or shrubs planted to protect structure from strong wind.
19. **Adlibitum:** All the time, provided without a measure or without limit.
20. **Acaricides:** Chemicals used to kill ticks.
21. **Furrowing crate:** Small metal cages in which pregnant sows are restrained before giving birth until piglets are weaned.
22. **Breeding crate:** Wooden or metallic and used during mating to prevent heavy boars hurting small sow.

23. **Mortality rate (also death rate):** Is a measure of the number of deaths in a particular population compared to the size of that population per unit of time.
24. **Mobility rate:** The ease and speed at which a disease spreads in an area.
25. **Biosecurity:** A set of measures designed to protect the farm from the entry and spread of parasites and diseases.
26. **Metabolites:** A product of metabolic action.
27. **Feed conversion ratio (FCR):** A measure of the animal's ability to change feed mass into desired input.
28. **Stocking rate:** The number of animals on a given amount of land over a certain period of time.
29. **Granules:** A small compact particle of a substance.
30. **Irritation:** State of inflammation or painful reaction of an allergy.
31. **Annoyance:** To become a nuisance or to irritate.
32. **Zoonotic disease:** A disease that is naturally transmissible from vertebrate animals to humans and from humans to the animals.
33. **Scolex:** The anterior headlike segment of a tapeworm having suckers and hooks for attachment.
34. **Sucker or scolex:** It is a muscular structure for suction on the host or substance.
35. **Hooks on scolex:** These are the parts of the structure called rostellum on the tapeworms head used for attachment.
36. **Proglottide:** It is a segment of tapeworm containing both male and female reproductive organs which detaches from the body and spreads the infective eggs.
37. **Sub-mucosal tissues:** A layer of connective tissues that supports the mucous membranes.
38. **Infective eggs:** A parasite egg with a developed larvae inside it.
39. **Definitive hosts:** The primary host in which a parasite reaches maturity and reproduces sexually.
40. **Secondary host** (also intermediate host): A host that harbours a parasite for a short development stage are completed.
41. **Therapeutic measures:** Services that are intended to help cure a disease.
42. **Whey:** The watery part of milk separated from coagulated curd.
43. **Piglets:** A young pig from birth to weaning.
44. **Sow:** A mature female pig after first parturition.

45. **Boar:** A mature male pig.
46. **Gilt:** A young female pig from weaning to first parturition.
47. **Lactation:** The secretion of milk from the mammary glands.
48. **Lactating sow:** Sow that is in milk and suckling young ones.

6.5 Problem statement: Guidance to the teacher

(a) Divide the learners in groups and instruct them to observe and study the photograph in the Student's Book page 28.

(b) Assist the learners to analyse the photographs as follows:
- Photograph 1– pigs reared in a traditional house
- Photograph 2 – a modern or standard chicken house
- Photograph 3 – pig suffering from coccidiosis
- Photograph 4 – chicken reared in traditional cage
- Photograph 5 – chicken reared in a standard or modern house

(c) Help the learners to find out the difference between the situations in photographs 1 and 2.

The difference they would bring out is that traditional houses are built of local materials such as banana fibres, grass or straws for thatch and earth for floor, while the modern chicken house in photograph 2 is build up of permanent materials such as iron sheets, timber and concrete.

(d) Guide the learners to find out what is happening in photograph 3 which shows a pig suffering from coccidiosis.

(e) Assist the learners in discovering how the chicken in photograph 4 and 5 are reared differently as follows:
- Chicken in photographs 4 are allowed to roam around, collecting what they can eat, for example insects and vegetation. They are given little supplementary feeds. The houses are used to shelter them at night. They tend to produce low.
- Chicken in photograph 5 are mostly confined throughout their life in house. They are fed on commercial feeds and experience high management practices. They have high production.

(f) Guide the learners to prepare possible solutions to such problems as shown in photograph include:
(i) Separating the sick animals to avoid spread to the healthy.
(ii) Give electrolyte fluid to the sick.
(iii) Improve the hygiene condition of the house such as keeping it dry, warm and clean.

6.6 Suggestions for accommodating Special Education Needs (SEN)

The teacher should identify the learners with special needs to show positive image of active inclusive education. They should be assisted to undertake all learning activities

like the others. The type of special needs and learners support is as shown in the table below.

	Type of special needs	Support for the learners
(i)	**Sensory impairment (hearing)**	Speak loudly so that all learners can hear. Seek for the learners' attention. Allow the learners to sit closer to the teacher.
(ii)	**Sensory impairment (visual)**	Use extra-large prints in practical sheets, questionnaires and assessment papers. Use large diagrams and bold letters on the chalkboard. Those with braille machines should be given enough space in class. Should be paired with the sighted for assistance.
(iii)	**Sensory impairment (motor)**	Allow those with the wheelchairs enough space to sit comfortably. Assign other learners to assist them in case of any movements. Practical activities to be conducted in one area to reduce constant movement.
(iv)	**Gifted or talented learners**	Assign them special tasks such as collecting and distributing materials required for the activities and taking them back. Give them extra work to do during group discussions such as preparing reports for presentations. Assign them to special needs learners in their groups for assistance.
(v)	**Slow learners**	Give them extra time to complete the tasks. Assist them when performing the activities. Attach them to talented learners.

6.7 List of lessons

Lesson No	Number of Periods	Weeks	Lesson Title
1	1	1st week	Standards of aviary and pigsty Fitting materials to construct and aviary and a pigsty
2	2	1st week (1 period) 2nd week (1 period)	Aviary and pigsty construction
3	2	2nd week (1 period) 3rd week (1 period)	Aviary and pigsty construction (cont'd) Non-ruminants feed (food and quantity for pig and poultry)
4	2	3rd week (1 period) 4th week (1 period)	Non-ruminants feed (food and quantity for pig and poultry) cont'd
5	2	4th week (1 period) 5th week (1 period)	Pig enemies and diseases and their characteristics
6	2	5th week (1 period) 6th week (1 period)	Pig enemies and diseases and their characteristics (cont'd) Farm sanitation (rules)
7	1	6th week	Farm sanitation (rules) cont'd End of unit assessment

6.8 Unit Summary

Confined birds are housed in structures called aviaries while pigs in pigsties. Ideal aviaries and pigsties should provide the proper conditions required for feeding, breeding exercises and protection from diseases and adverse climatic conditions. They should be constructed with materials that are affordable, available and able to keep the animals safe.

Standard aviaries constructed should cater for different groups of poultries according to sex, development stage and species. Thus, different groups of birds should be housed separately since they require different housing conditions. The same is applicable to the pigs. Different groups of pigs require different housing conditions. Therefore, the units of housing which is known as pens should be constructed to cater for the pigs according to their sex and development stage.

Pigs and poultry are non-ruminant and so feed on diets they can easily handle. The food for the pigs consists of grain offals such as industrial by-products from grains and by-products from animal tissues such as meat and bone meal, milk and milk products, blood flour, water and oil cakes. In addition to most of these foods, poultry require insects, sprouted fodder and whole grains. Their feeding follow different feeding plans which should be adhered to strictly.

Poultry and pigs are attacked by many enemies and diseases. The enemies are referred to as parasites which deprive the birds and pigs of their food, as well as transmit some diseases. The common external parasites include lice, fleas, mites, ticks, fleas and mosquitoes. These are controlled through spraying and dusting using effective insecticides and acaricides.

Poultry and pigs are also affected by internal parasites which include different types of worms. These have adverse effects on the health of the livestock and intensive control is important. Methods such as maintenance of hygienic conditions through cleaning and disinfection, deworming and proper sanitation by humans help to reduce transmission.

Diseases that attack pigs include taeniasis, pasteurellosis, brucellosis, porcine epidemic diarrhoea and coccidiosis. Some of these diseases are viral and lead to losses of animals while others are bacterial and can be treated. Vaccination, provision of antibiotics, disinfection and maintenance of biosecurity are all integrated methods of controlling these diseases.

Diseases that affect poultry include Newcastle disease, pullorum, coccidiosis, mycotoxicosis and Marek's disease. Most of these diseases are viral. However, poultry diseases do not affect human beings though they lead to huge economic losses in terms of capital invested. Effective control measures include vaccination, farm sanitation and maintaining biosecurity in the farm.

6.9 Additional information for the teacher

Rearing systems of poultry: When keeping a poultry enterprise, the following systems can be used:

(a) Battery cage system
(b) Deep litter system
(c) Fold system
(d) Free range system

Battery cage system

In this system, the birds are confined in cages throughout their life. The cages are made of wire mesh. Each cage can contain 1–3 birds to provide about 0.2 m^2 per bird. Cages are then arranged one on top of the other to form tiers. Each tier should contain about 20 – 24 cages. The lowest tier should contain about 60 – 90 cm above the floor to allow for cleaning. The tiers are spaced on the floor in such a way that they allow space for movement during cleaning. This gives several units of tiers in the house. Each tier is provided with linear water trough, feed trough and one egg tray on the front part. The egg tray is slightly slanting to allow the eggs to roll with the ease from the floor of the cages. This prevents the birds from eating the eggs. Sometime the feeding, watering and egg collection can be mechanised especially in areas with electricity.

Battery cage system

Deep litter system

This is also an intensive system where birds are confined throughout their life. Birds are raised on the floor of an open house where equipment such as feeders, waterers and laying boxes are provided. The house is a deep litter house due to the fact that the bedding materials placed on the floor known as litter accumulate with time to build up to 30 cm deep on the floor.

This litter keeps the birds warm, absorbs any water spillage and also the droppings from the birds. It is not removed at any time when the birds are growing except as manure when the birds have been sold. The litter is made up of wood shavings, crushed maize cobs or chopped hay. It is raked at least once a week to keep it dry. The space requirement for the birds on the floor should be 1 m^2 per 2–3 birds. Birds should be provided with roosts and perches especially when they are idle. The system is cheaper compared to the battery cage system.

Deep litter system

Fold system

This is a semi-intensive system of rearing poultry. Birds are confined in small portable structures called folds. A fold looks like a triangular ark with rollers on the base for movement. It measures 3.5 m long 1.5 m wide and 1.5 m high. About one third of the roof should be covered with iron sheets to provide shelter for the birds. The rest of the roof is left open but covered with wire mesh to restrict the birds from getting out. The floor of the fold should be slatted or made of mesh wire to allow droppings to fall off to the ground. The unroofed part of the roof allows the birds to get the sun. Each fold unit can hold 10 –15 birds. The fold should be moved by rolling to fresh ground everyday to prevent accumulation of droppings and to spread manure. The birds can also eat fresh grass to supplement their feeds. Feeders' waterers and laying box compartment are placed outside the folds.

6.10 Suggested Answers to End of Unit 6 Assessment (pages 352 – 353 of Students' Book)

1. (i) Non-ruminants have simple/single stomach while the ruminants have complex/four compartment stomachs.
   (ii) Non-ruminants do not chew cud while the ruminants chew cud.
   (iii) Non-ruminants cannot be able to handle alot of coarse plant materials

in their diets while the ruminants are able to handle a lot of coarse plant materials in their diets.

(iv) Non-ruminants harbour limited micro-organisms in their caecum while ruminants harbour a large number of micro-organisms in their rumen.

2. A non-ruminant is a monogastric animal which does not chew cud and therefore not able to break the crude fibre found in plant materials.
3. (i) Corrugated aluminium sheets – roof/walls
   (ii) Dried grass – roof
   (iii) Concrete block – walls
   (iv) Chicken wire mesh – ventilators
   (v) Concrete – floors/drainage channels
   (vi) Timber offcuts – walls

4. A good material for roofing a poultry house should have the following qualities:
   (i) Be leak proof.
   (ii) Strong to withstand strong wind.
   (iii) Light weight to avoid heavy pressure on the walls.
   (iv) Should offer insulation against sound and heat.
   (v) Be of good appearance to provide beauty

5. (i) Diarrhoea
   (ii) Dysentery or blood in the diarrhoea
   (iii) Emaciation
   (iv) Dung may be yellow to grey-green in colour.

Disease	**Animal attacked**	**Causal agent**
Marek's	Poultry	Virus
Pasteurellosis	Pigs	Bacterium/pasteurella-septicum
Mycotoxicosis	Poultry	Infected feeds
Brucellosis/contagious abortion	Pigs	Bacterium/Brucella suis

6. (a) Tapeworm/Taenia solium
   (b) (i) Swellings or lumps under the skin of the jaws
   (ii) The animal is emaciated.
   (c) (i) Deworming with anthelmintics.
   (ii) Giving clean feeds and water.
   (iii) Proper disposal of human wastes.

7. (i) It reduces the overall feed costs.
   (ii) Birds produce better tasting eggs.
   (iii) Eggs produced have a more vibrant yellow coloured yolks.
   (iv) Improves the laying percentage.
   (v) Improves the health condition of the birds.

6.11 Remedial activities for slow learners

1. Give an account of how sprouting fodder for chicken is carried out.

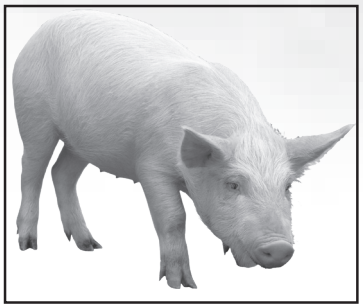
Answer

(i) Select the type of grains to be sprouted, for example, barley.
(ii) Soak the grains in water for 12–24 hours.
(iii) Drain off the water and rinse the grain.
(iv) Pour the soaked grains on a shallow tray or wet gunny bags in layers of 2.5 cm deep to allow air to go through.
(v) Place the grains in a sunny area.
(vi) Rinse and sieve the grains through line wire mesh about 2–3 times a day within the first few days until they start rooting.
(vii) Avoid disturbing the grains when they start sprouting.
(viii) Let the grain produce a growth of 10–15 cm sprouts for them to be ready for use.

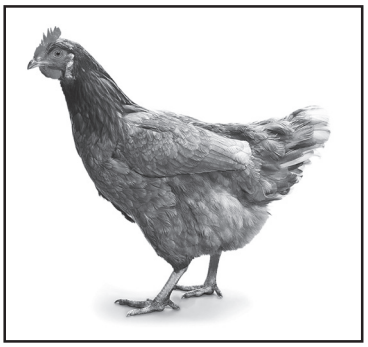
2. Name three sites where pig louse can be found on the body.
   (i) Neck
   (ii) Jowl
   (iii) Flanks
   (iv) Inner legs
   (v) Ears

3. What is a non-ruminant animal?
   This is an animal that does not chew cud and has only one stomach compartment hence cannot digest a lot of fibrous plant materials.
4. The diagrams labelled A, B, and D show different types of animals kept in the farm. Study them carefully and identify the animals which are non-ruminant.

A



B



C

D

Non-ruminants are:

(b) Pig

(c) Chicken

5. Suggest two practices that are carried out to maintain proper sanitation in a poultry house.
   (i) Disinfectant at the entry.
   (ii) Cleaning the poultry equipment.
   (iii) Avoiding mixing birds from other flocks.

6.12 Extension activities for gifted and talented learners

1. Describe pasteurellosis disease in pigs under the following sub-headings:
   (a) Cause
   (b) Symptoms of the acute form of disease
   (c) Control measures

Answer

(a) Bacterium/pasteurella septicm

(b) (i) Rise in body temperature/a body temperature of 42^{o}C

(ii) Muscular twitching

(iii) Swellings on the throat
(iv) Difficult breathing
(v) Loss of appetite

(c) (i) slaughtering infected animals in chronic form
(ii) Vaccination
(iii) Proper housing
(iv) Proper feeding

2. Suggest by-products of milk given to pigs.
   (i) Cheese whey
   (ii) Skim milk
   (iii) Ice cream mix
3. Give two uses of the creep area in a pigsty
   (i) The enclosure where the piglets are provided with warmth.
   (ii) Creep feeding is carried in this area to prevent the mother from eating creep feed for the piglets.
   (iii) Piglets escape to this area for safety from the mother.
4. Distinguishing between layers and broiler birds
   Layers are birds or chicken kept for egg production while broilers are chicken or birds kept for meat production.
5. Mention three qualities of materials used in roofing an aviary
   (i) Should be leak proof.
   (ii) Light weight to avoid pressure on the walls.
   (iii) Strong to withstand the effect of strong wind.
   (iv) Offer insulation against sound and heat.
   (v) Of good appearance and beauty.

6.13 Structure of every lesson

Lesson 1: Standards of aviary and pigsty and fitting materials to construct an aviary and a pigsty

Learning objectives

(a) Knowledge and understanding:
Explain the conditions suitable for aviary and a pigsty.

(b) Skills:
(i) View the standards of aviary and pigsty
(ii) Select and gather the materials to construct an aviary and a pigsty

(c) Attitudes and value:
(i) Be active in the discussions of an aviary and a pigsty
(ii) Manipulate carefully an aviary and a pigsty construction materials.

Prerequisites/Revision/Introduction

Teacher asks learners the questions on animals reared to test if they know some of them:

- What are animals reared in Rwanda that you know?
- How are they reared?

Teaching Aids

- Aviary
- Pigsty
- Timber
- Birds
- Cement
- Iron sheets
- Nails

Learning activities

Research and discussion

The teacher to organise for a field visit, prepare a questionnaire as shown in Annex 19 and instruct the learners on the trip. Learners to make observations of aviary and pigsty standards, discuss and present their findings to the class and take notes given by the teacher.

The teacher to divide learners in groups and instructs them to find out fitting of materials to construct aviary and pigsty. Learners to give their opinions freely, discuss and present their findings and take the teacher's notes. Teacher to summarise the discussion.

Synthesis

The teacher guides learners to summarize their findings after discussion on standards of aviary and pigsty and materials used to construct aviary and pigsty (pages 283 – 293 of Students Book).

Assessment

Explain the conditions suitable for a pigsty.

(a) Temperature: The temperature requirement for the pigsty depends on the age of the pigs housed, for example, piglets require a temperature of 27–30^{o}C while the adult pigs require a temperature of 16^{o}C.

(b) Draught: Should be free from draught to avoid chilling which may cause pneumonia.

(c) Dryness: The floor should always be dry. To avoid dampness dry bedding should be provided on the floor.

(d) Ventilation: There should be proper air circulation to remove dampness and bad odours.

(e) Lighting: The house should be well lit.

(f) Hygiene or cleanliness: Should be cleaned to avoid disease infection and to remove droppings and urine every day.
(g) Space requirement: All groups of pigs should be given enough space on the floor, feed and watering troughs to prevent fighting.

Suggest the qualities of materials for constructing an aviary and pigsty.

(i) Should be suitable to the weather condition of the area.

(ii) Should be easily available.

(iii) Should be affordable to buy.

(iv) Should be durable.

Lesson 2: Aviary and pigsty construction

Learning objectives

(a) Knowledge and understanding:
  (i) Carry out a construction of an aviary and a pigsty
(b) Skills:
  (i) Construct an aviary and a pigsty
(c) Attitudes and values:
  (i) Participate willingly in the construction of an aviary and a pigsty.

Prerequisites/Revision/Introduction

Teacher prepares, questions related to the materials used to construct an aviary and a pigsty and asks learners to review the previous lesson.

Teaching Aids

- Aviary
- Timber
- Bricks
- Cement
- Water
- Iron sheets
- Nails
- Roofing Materials
- Wire mesh
- Electrical wiring materials
- Binding wires
- Water pipes
- Cedar posts
- Chicken wire mesh

Learning activities

Supervised activity

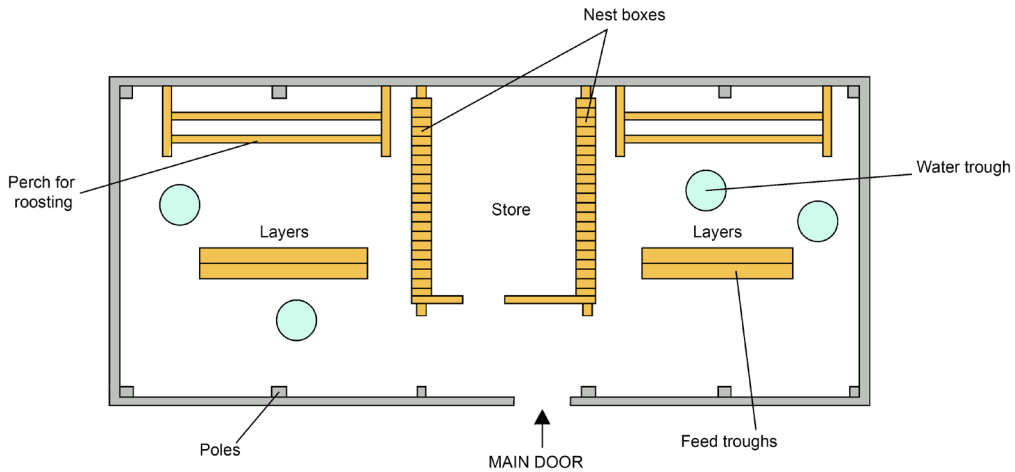
Teacher to instruct learners to construct aviary and pigsty, provide materials and supervise constructions. Learners to discuss and present their findings and take the teacher's summary notes. Teacher to give guidance during the construction.

Synthesis

The teacher gives guidance to learners on construction of aviary and pigsty after they have discussed and presented their findings (pages 295 – 300 of Student's Book).

Assessment

1. States the three parts of an aviary construction.
   Construction of the roof, floor and wall.
2. Using a diagram, illustrate the layout of a chicken house.



Lesson 3: Aviary and pigsty construction and non-ruminant feeding (food and quantity)

Learning objectives

(a) Knowledge and understanding:
   (i) Carry out a construction of an aviary and a pigsty
   (ii) List the ingredients of an appropriate ditch for the pig or poultry
   (iii) Quantity and feeding plan for a pig

(b) Skills:
   (i) Construct an aviary and a pigsty
   (ii) Select an appropriate food for a pig
   (iii) Practice pig feeding

(c) Attitudes and values:
   (i) Participate willingly in the construction of an aviary and a pigsty.
   (ii) Participate actively in group discussion and interact positively with the colleagues.
   (iii) Be careful and cautious while distributing food for pig.

Prerequisites/Revision/Introduction

The teacher helps learners to review the previous lesson by asking directive questions related to the aviary construction procedure.

Teaching Aids

- Pigsty
- Timber
- Bricks
- Questionnaires
- Water
- Iron sheets
- Nails
- Chick starter mash
- Growers mash
- Electrical wiring materials
- Binding wires
- Note books
- Computer connected with internet
- Text book
- Dictionary
- Broiler
- Layers
- Cement

Learning activities

Supervised activity: Teacher to instruct learners to construct aviary and pigsty, provide materials and supervise constructions. Learners to discuss and present their findings and take the teacher's summary notes. Teacher to give guidance during the construction.

Field visit: Teacher to organise for a field visit, prepare a questionnaire as shown in Annex 20 and conduct the visit. Learners to make observations on feeding of poultry and pigs, discuss and present their findings and take the teacher's summary notes.

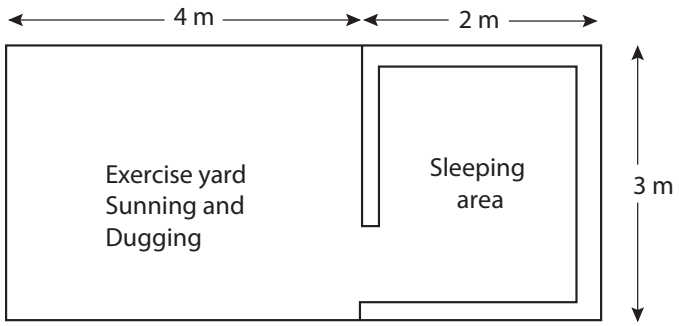
Discussion: The teacher to divide learners in groups and instructs them to discuss food for pigs. Learners to give their opinions from references provided, discuss and present their findings to the class and take summary notes given by the teacher.

Synthesis

The teacher to give guidance on how to construct pigsty and consolidates the learner's findings after discussion on pig feeding (pages 300 – 313 of Student's Book).

Assessment

1. Using diagram, illustrate a layout of a Boar pen.



2. Explain the components of a pig diet.

Pig diet is composed of the following:

(a) **Grain offals**

Like poultry, pigs eat grain offals such as grain hulls, bran germ, gluten, middlings, grain screenings, groats, mill run, maize hominy, rice polishings, wheat red dog and wheat shorts.

(b) **Industrial by-products**

The primary aim of using industrial by-products to feed pigs is to reduce the cost of raising pigs. A variety of by-products are available for pig diets. They include:

(i) Wheat middlings – these are by-products of flour milling industry. Their feed value is related to how much flour is removed from the grain when milling. They contain 15–17% crude proteins, 8.5% crude fibre, 4% fat and high in calories values. About 30% of pelleted feeds for pigs is made of midds. However, midds can be a significant source of mould and mycotoxin in swine feeds if not well stored.

(ii) Bakery by-products – these are by-products of baking and cereal industries. They vary in nutritive value depending on the source, for

example, pasta, cookies, cereal fines and flakes. They should be given when fresh since they are high in fat and subject to oxidative rancidity. They can also become mouldy if stored for too long or not dried properly. Overdrying may reduce lysine availability. They contain 11% crude protein, 0.24 lysine, 10% fat and high calories value.

(iii) Meat and bone meal (MBM) – pigs can be fed on meat and bone meal from ruminant slaughter industries. MBM from ruminants contain 50% crude proteins, 9% calcium, 4.4% available phosphorus, 2.08% lysine and high calorific value.

(iv) Liquid by-products include:

- Cheese whey: this is liquid dairy by-products which contain 5% dry matter, 12 – 13% crude proteins and 60 – 70 % lactose. The salt (sodium) contact may be variable and normally limits the use of whey as a pig feed. It is particularly good for feeding growing pigs. It is a by-product of making cheese from milk.
- liquid wheat starch: by-product of extraction of starch and gluten from wheat. It contains 25% dry matter, 50 – 60% sugars and starch and 10–12% crude protein. Excessive intake of sugars may cause secretory diarrhoea in young pigs.
- Potatoes steam peel: residue from the process of peeling potatoes using pressure and high temperature. It contains 14% dry matter, 13% crude proteins and 40 – 50% starch and sugars. However, solanine in potatoes might cause poisoning in young pigs. Too much of potatoes peel feed should be avoided.
- Skim or whole milk: whole milk contains 12% dry matter, 28% crude proteins and 4% lactose. Skim milk contains 9 – 10 % lactose.
- Ice cream mix: a fat rich by- product that is usually a blend of residual ice cream lots and other dairy ingredients. Contains 28% dry matter, 8% proteins, 20% fat and 60% lactose. It is necessary to monitor its nutritional level constantly since it can change.
- Semi-moist dried distillers grain with solubles (DDGS): it is an excellent alternative liquid feed in pigs. It reduces cost of feeding and does not require careful monitoring.

(c) **Tubers**

Root tubers constitutes a rich source of carbohydrate energy in the diet of pigs. The energy in roots is in form of starch which is similar in starch from cereals. The root tubers include:

- Cassava: Cassava roots contain 30 – 40% dry matter depending on variety, soil type, moisture and age of the roots, with starch being about 90% of the total dry matter. They have 2 – 4% crude protein.

The roots also contain vitamin C, thiamine, riboflavin and niacin.

However, the presence of cyanogenic glycoside in cassava limits its use in pig diet though chopping, crushing followed by sun-drying removes the glycoside and the hydrocyanic acid. Boiling removes cyanide and glycoside. Drying with hot air removes both hydrocyanic acid.

The digestibility of cassava based diets has shown to be superior to that of cereals. Cassava are fed to pigs in form of cassava root meals, cassava root silage and as fresh cassava roots.

- Sweet potato: Sweet potato roots contain high starch content, vitamin A, ascorbic acid, thiamine, riboflavin and niacin. Fresh vines also provide up to 27% dry matter, 40% protein for growing and finishing pigs.
- Sweet potatoes are fed as raw roots, cooked peeled and non-peeled. The cooked forms are more digestible than the raw and hence increases average daily weight gain faster. They can be used to completely substitute maize.

(d) **Blood flour**

This is also known as blood meal. It is a dry powder made from animal blood. It usually comes from livestock slaughter house by-product. It is collected during slaughter, dried and made into blood meal.

Blood meal contains protein and is used to supplement diets based on cereal grain plant and by-products and forages. The method used to dry the blood does not affect the nutritional quality of the protein in the meal.

Methods of drying blood

(i) Batch dry rendering – it involves the cooking of whole blood in a jacketed cylindrical cooker that is heated indirectly by steam at a high pressure.

(ii) Ring dried rendering – this involves coagulating the blood by steam heating. The coagulum is centrifuged and dried with hot gas in a ring drier.

(iii) Spray dried rendering – Spray dried blood meal is manufactured using a similar method for skim milk powder. In this case, the liquid blood is sprayed inside a warm chamber and then becomes fine powder instantly.

Ring dried and spray dried blood meal have a greater content of total and available amino acids which is of better nutritional quality. Blood meal can also be solar or oven dried by small-scale farmers. Blood is collected in large pans and boiled slowly while constantly stirring. It is reduced to a moisture content of 10 –12% and then spread on a concrete floor for sun-drying.

It is fed mixed with bran or other by-products from cereal grains. Drum drying is also done where raw blood is made to form a free-flowing slurry that is deposited

onto the surface of a heated drier drum to form a film. The film is rapidly dried and scraped off and made in flakes.

(e) **Grasses**

Pigs pick some grass from the sunning yard and when foraging. However, the digestive system is not adopted to digest the cellulose in grass since they have a simple stomach. Therefore, pigs make little use of grass. Fresh grass contain a lot of vitamins and water. The grass provides the roughage needed to facilitate the movement of food through the gut and, therefore, prevent constipation.

(f) **Concentrates**

This is a feedstuff which contain high nutritional value and little fibre. There are two types of concentrate feeds, the energy concentrates and the protein concentrates. While the energy concentrates contain high carbohydrate content for energy, the protein concentrates are rich in proteins. The concentrates fed to pigs are well balanced with carbohydrates, proteins, vitamins and minerals. The type of concentrate feeds given to pigs depends on the age, size, breeding stage and environment.

(g) **Water**

Water is the most abundant compound and performs important functions in the body of pigs. Pigs require water for various reasons, which include, metabolic functions, adjustment of body temperature, movements of nutrients into the body tissues, removal of metabolic waste, production of milk and for growth and reproduction. In general, pigs require 9 – 23 litres of water per day depending on the production stage.

(h) **Oil cake**

These are coarse residues obtained after oil is extracted from the oil seeds. They are rich in proteins, minerals and are valuable as feeds. The feed is in form of a solid compressed/solid cake. There are different types of oil cakes:

(i) Groundnut cake: This is widely used in pig feed due to its low fibre and high protein content. However, it has a high risk of aflotoxin if poorly stored.

(ii) Cotton seed cake: Levels of cotton seed cake fed to pigs and poultry go up to 10% of total feed intake.

(iii) Sunflower seed cake: These are used freely to balance diets of pigs and poultry since they have no toxic compounds.

(iv) Palm kernel cake: This is low in protein content as compared to the other oil seed cakes.

Lesson 4: Non Ruminant feeding (feed and quantity for poultry and pigs)

Learning objectives

(a) Knowledge and understanding:
  (i) with the ingredients for appropriate diet for poultry
  (ii) Find the ingredients of an appropriate diet for pigs, poultry on pet their growth age
  (iii) Describe a feeding plan for a poultry

(b) Skills:
  (i) Select an appropriate food for the poultry
  (ii) Practice poultry feeding plan.

(c) Attitudes and values:
  (i) Participate actively in group discussion and interact positively with colleagues.
  (ii) Observe attentively the food distribution operation for the pigs and poultry
  (iii) Be careful and cautious while distributing for poultry.

Prerequisites/Revision/Introduction

Cautiously, the teacher asks questions to learners on pigs feeding (type of food and quantity) to review the previous lesson.

Teaching Aids

- Aviary
- Computer connected with internet
- Creep feeds
- Text books and library books
- Pig finisher meal
- Pigsty
- Questionnaires
- Sow and weaner meal
- Water

Learning activities

Supervised activity: Teacher to provide feeding materials, supervise the feeding and allow learners to carry out feeding. Learners to feed the poultry, discuss and record their findings then present them to class. Teachers to give summary notes.

Discussion: The teacher to divide learners in groups and provide video tapes and references on pigs and poultry diseases and enemies. Learners to research on poultry and pig diseases, discuss and present their findings to class and then take notes given by the teacher.

Synthesis
The teacher guides learners to summarise the lesson on pig and poultry feeding according to the development stage, species and breed (pages 302 – 308 of Student's Book).

Assessment
List the types of pig feeds that are made from grain offals.

Answer
(i) Bran
(ii) Hornings
(iii) Germ
(iv) Gluten
(v) Grain hulls
(vi) Grain screenings
(vii) Groats
(viii) Middlings
(ix) Mill runs/mill products
(x) Rice polishings
(xi) Wheat red dog
(xii) Wheat shorts

Lesson 5: Pig enemies and diseases

Learning objectives
(a) Knowledge and understanding:
  (i) Identify the names and describe pig common diseases and enemies.
  (ii) Describe death control methods in pig farm.
(b) Skills:
  (i) Recognize the pig diseases by their symptoms in the farms.
(c) Attitudes and values:
  (i) Be active in group discussion and interaction
  (ii) Have a positive attitude when interacting with the colleagues.
  (iii) Be attentive and diligent in observing a sick pig and the discussion on the state of the farm.

Prerequisites/Revision/Introduction
The teacher asks questions to the learners on feeding of pig and poultry to review the previous lesson.

Teaching Aids

- Pigsty
- Videos of pig discuss and enemies drugs used in disease prevention
- Materials used in distributing drugs
- Pig feeds
- Tools and equipment for pig.
- Magazines and colour photographs of pigs.

Learning activities

Field visits

Teacher to organise for a trip, prepare a questionnaire as shown in Annex 21 and conduct the trip. Learners to observe pig diseases and enemies, discuss, record and present their findings and take the teacher's summary notes.

Teacher to organise a field trip and prepare a questionnaire as shown in Annex 22. Teacher instructs the learners to make observations on poultry diseases, discuss and present their findings to the class. The teacher gives summary notes and final conclusion.

Answers to Exercise 6.3 (page 337 of Students Book)

Diagram	Practise	Disease controlled
(a)	Vaccinating piglet	Pasteurellosis Brucellosis Porcine Epidemic Diarrhea (PED)
(b)	Cleaning pigsty	Coccidiosis Porcine Epidemic Diarrhea (PED) Brucellosis Taeniasis
(c)	Isolating a sick pig	Coccidiosis Brucellosis
(d)	Feeding a piglet with a bottle	Pasteurellosis

Synthesis
The teacher guides the learners to summarise their findings through identification of pigs on pictures (page 320 – 337 of Student's Book).

Assessment
Describe pasteurellosis disease in pigs under the following sub-headings.
1. Causes
2. Symptoms of the acute form of disease
3. Control measures

Answer
(a) Bacterium/pasteurella septicum
(b) (i) Rise in body temperature/a body temperature of 42^{o}C
(ii) Muscular twitching
(iii) Swellings on the throat
(iv) Difficult breathing
(v) Loss of appetite
(c) (i) slaughtering infected animals in chronic form
(ii) Vaccination
(iii) Proper housing
(iv) Proper feeding

Lesson 6: Poultry enemies and diseases and farm sanitation

Learning objectives
(a) Knowledge and understanding:
(i) Identify the names and describe poultry common diseases and enemies.
(ii) Describe death control methods in poultry farms
(iii) Apply sanitation feeds in the laminated farm.
(b) Skills:
(i) Recognise poultry diseases by their usable symptoms in the farm
(ii) Practice rules of sanitation in the poultry farm.
(c) Attitudes and values:
(i) Be attentive and diligent in observing a sick poultry and the sanitation state of the farms.
(ii) Cooperate with the colleagues to carry out the sanitation rules.

Prerequisites/Revision/Introduction
Teacher asks questions to the learners on pig enemies and diseases and their characteristics to review the previous lesson.

Teaching Aids

- Aviary.
- Video of poultry diseases and enemies.
- Drugs used in disease prevention materials used in distributing drugs.
- Different poultry feeds.
- Equipment for poultry.

Learning activities

Field visit

Teacher to organise a field trip and prepare a questionnaire as shown in Annex 22. Teacher instructs the learners to make observations on poultry diseases, discuss and present their findings to the class. The teacher gives summary notes and final conclusion.

Teacher prepares a questionnaire as shown in Annex 2 and instructs the learners to carry out farm sanitation in poultry and pig houses. Learners discuss then present their findings to class. Teacher gives summary notes and concludes the lesson.

Answers to Exercise 6.2 table 6.8 (page 328 of Student's Book)

Parasite identity	**Effects**
Chicken mite	Suck blood leading to drop in egg production and death of young chicks.
Scaly leg mites	Cause scales and abnormal enlargement of feet.
Poultry lice	Loss of weight, egg production drops and death of young chicks.
Fowl tick	Suck large quantities of blood leading to anaemia.
Fleas	Suck blood leading to stress and emaciation.
Bed bug	Suck blood leading to emaciation, stress and loss of condition.
Fly	Cause annoyance and irritation.

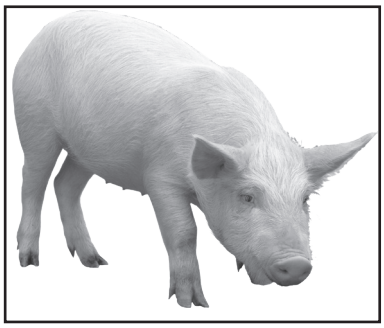
Synthesis

Teacher consolidates the findings of learners on enemies and diseases of poultry as a summary of lesson (page 338 – 344 of Student's Book).

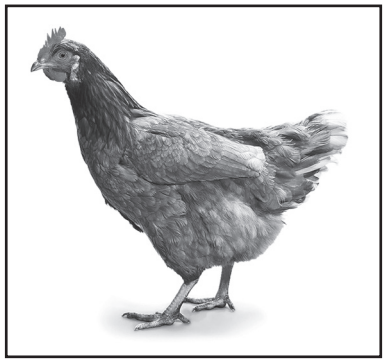
Assessment

The diagrams labelled A, B, C and D shows different types of animals kept in the farm. Study them carefully and identify the animals which are non-ruminants.

A



B



C

D

Non ruminants are

(a) Pig

(b) Chicken

Suggest two practices that are carried out to maintain proper sanitation in a poultry have.

- Disinfectant at the entry
- Cleaning the poultry equipment
- Avoiding mixing birds from other flocks

What is mycotoxicosis in poultry?

Mycotoxicosis is a secondary infection from fungi brought about by eating fungal infected grains or feeds.

Lesson 7: Farm sanitation (rules for pig and poultry farm sanitation)
Learning objectives

(a) Knowledge and understanding:
    (i) Apply sanitation rules in the laminated farm
(b) Skills:
    (i) Practice rules of sanitation in the pig and poultry farms
(c) Attitudes and values:
    (i) Co-operate with the colleagues to carry out the sanitation rules.

Prerequisites/Revision/Introduction

The teacher asks learners directive questions on enemies and diseases of poultry to review the previous lesson.

Teaching Aids

- Drugs used in disease prevention in pigs.
- Materials used in distributing drugs.
- Tools and equipment for pig and poultry.
- Hose pipes.
- Disinfectants
- Antiseptics
- Matchboxes
- Pigsty with pigs.
- Poultry house with birds.

Learning activities
Field visit

Synthesis

The teacher guides learners to summaries their findings on rules for pig and poultry farm sanitation (pages 345 – 348 Student's book).

Assessment

Discuss the sanitation conditions in pig production

Answer

Sanitation conditions in both poultry and pig production include:

1. The houses should be constructed away from other livestock premises and away from roads connecting to other livestock premises.
2. The houses should be constructed of materials which can be easily cleaned and disinfected.
3. All vegetation around these premises should be cleared.
4. Drinking water source for the animals and birds should be in a place away from contaminants and pollutants.
5. Water source should be close and with enough water especially for the pigsty.

6. Waste water from premises should have a proper drainage to keep the area dry and free from flies.
7. Litter and manure from the floor of the houses should be removed and heaped for composting at the distant and covered with polythene sheets.
8. The maintenance of a disinfection system or foot bath at the entrance of each house prevents introduction of infectious organisms.

Unit 7 Integrated livestock-fish farming

7.0 Key Unit Competences

Learners should be able to successfully run an integrated livestock-fish farm.

7.1 Prerequisite knowledge and skills

Learners should have knowledge and practical skills in livestock production such as selection and breeding, feeding, housing, parasite and disease control and obtaining livestock products from the animals. They also need to have knowledge and skills in crop production and economical use of land especially where there is shortage of land.

7.2 Cross-cutting issues to be integrated in teaching and learning activities

(i) **Environment and sustainability:** The teacher should sensitise the learners on the importance of conserving the environment for the sustainability of agricultural production.

(ii) **Standardisation culture:** The teacher to inculcate in the learners the importance of standards in whatever they are doing as a pillar of economic development.

(iii) **Peace and values education:** The teacher should sensitise the learners on the importance of peace in economic growth and development. Without peace there cannot be any economic activities going on and this leads to poverty.

(iv) **Financial education:** The teacher should sensitise the learners on the need for sound financial management to real life situations especially in the area of spending, saving, borrowing and investing.

7.3 Generic competences:

- **Critical thinking and problem solving skills** – The acquisition of such skills will help learners to think imaginatively, innovatively and broadly to evaluate and find solutions to problems encountered in our surrounding.

- **Creative and innovation** – The acquisition of such skills will help learners to take initiatives and use imagination beyond knowledge provided in classroom to generate new ideas and construct new concepts.
- **Research** – This will help learners to find answers to questions based on existing information and concepts and use it to explain phenomena from gathered information.
- **Communication in official languages** – Teachers, irrespective of being language teachers, will ensure the proper use of the language of instruction by learners. The teacher should communicate clearly and confidently and convey ideas effectively through spoken and written modes by applying appropriate language and relevant vocabulary.
- **Co-operation, inter personal management and life skills** – This will help the learners to co-operate as a team in whatever task assigned to practise positive ethical moral values while respecting rights, feelings and views of others. Perform practical activities related to environmental conservation and protection. Advocate for personal, family and community health, hygiene and nutrition and responding creatively to a variety of challenges encountered in life.
- **Lifelong learning** – The acquisition of such skills will help learners to update knowledge and skills with minimum external support. The learners will be able to cope with evolution of knowledge advances for personal fulfillment in areas that are relevant to their improvement and development.

7.4 Key terms

1. **Integration:** The act or process of combining two or more things to come up with something whole/The act of making something a part of a large group or organisation.
2. **Integrated livestock-fish farming:** A farming system where fish are reared in combination with other livestock animals.
3. **Cultured fish:** Fish that are reared in ponds.
4. **Planktons:** Lower forms of life such as algae which serve as the natural food for fish.
5. **Ecosystem:** This is a natural community of interacting organisms and their physical environment.
6. **Diversification:** The practice of allocating productive resources into different enterprises so that should one fail, the farmers benefit from the others.
7. **Sustainable resources management:** This is the utilisation of resources in a manner that ensures the resources remain productive for generations to come.

8. **Enterprise:** A single unit of production.
9. **Integrated livestock-fish farming infrastructure:** These are shelters used for rearing/keeping the various components of animals in an integrated fish farm.
10. **Integrated fish pond:** A fish pond which is constructed in such a way that it has provisions for keeping livestock in shelters constructed either above it or adjacent to it.
11. **Fingerlings:** Young/juvenile fish about the size of the human fingers.
12. **Aviary:** Structures in which poultry are reared/kept or simply poultry houses.
13. **Rabbit hutch:** A rabbit house.
14. **Pond fertilisation:** Addition of manures or inorganic fertilisers to the pond to stimulate the growth of planktons.
15. **Roughages:** Livestock feed that have a high crude fibre content with low protein and carbohydrate content.
16. **Concentrates:** Commercial livestock feed which have a high protein on carbohydrate content and a low fibre content.
17. **Feed plan:** A feeding schedule for fish which is based on the species and population of fish reared in a pond.
18. **Fish pond enemies:** Animals that either kill fish for food or cause injury to the fish.
19. **Fish predators:** Animals that kill fish for food.
20. **Lesion:** A region in an organ or tissue that has suffered damage through injury or disease.
21. **Antibiotics:** Drugs used in the treatment and prevention of bacterial infections.
22. **Stress:** Any form of discomfort/threat to the wellbeing of an organism.
23. **Stressor:** An agent of stress/anything that cause stress to a living organism.
24. **Vaccination:** The administration of a vaccine (antigen) to stimulate the individual's immune-system to produce antibodies that combat any form of foreign body protein/antigen.
25. **Medicated bath:** Medicine dispersed in water which is used in controlling external body disorders in animals.
26. **Sanitation measures:** These are hygienic means of promoting and protecting the health of animals.

7.5 Problem statement: Guidance to the teacher

(a) Divide learners in groups and then instruct them to use the pictures provided on page 355 of the Student's Book to carry out the activities.
(b) Guide the learners to analyse photographs 1, 2 and 3 after observation. They should come up with such observations as:
- Photograph 1 – shows fish-poultry integration farm.
- Photograph 2 – shows fish-poultry-vegetation integration.
- Photograph 3 – shows fish-rabbit-vegetable integration.

(c) Help the learners to deduce what is happening in photographs 4 and 5.
- Photograph 4 shows that fish die when they are removed from the water.
- Photograph 5 shows a fish eating bird, the kingfisher, which is a dangerous fish predator.

(d) Assist the learners to prepare solutions for the problem in photograph 4.
Solution – Fish in the ponds should be provided enough water all the rime. They should be removed from the water only when they are harvested.
(e) Instead of transporting livestock manure, the farmer should integrate livestock with fishes.
(f) Allow the learners to present their findings to the class.

7.6 Suggestions for accommodating Special Education Needs (SEN)

When teaching this unit, special education needs learners can be assisted as follows:

	Types of special need	**Assistance to the learners**
(a)	**Visual impairment**	Use of large prints in the instruction sheets and assessment papers. Allow the learners to sit near the chalkboard when in class. Pair them with learners with good vision.
(b)	**Hearing impairment**	Be audible enough to the learner. Ask them whether they have heard. Allow the learners to stay close to the teacher.
(c)	**Motor impairment**	Conduct group activities in one place to avoid too much movement. Pairing them with other learners so as to be assisted in carrying heavy items. Giving them lighter tasks when carrying out practical activities.

(d)	**Gifted or talented learners**	Assign them extra tasks when they finish assignment earlier than others, for example, report writing and presentation. Ask them to assist slow learners. Place them in different working groups.
(e)	**Slow learners**	Give them extra time to complete the task. Assist them in performing the task. Attach them to talented learners. Give them tasks which are not very challenging.

7.7 List of lessons

Lesson No	Number of Periods	Weeks	Lesson Title
1	1	1st week	Definition of integrated livestock fish farm Importance of integrated livestock fish farm
2	1	1st week	Types of integrated livestock - fish farms as per the animals reared and the features of animals species and breeds reared
3	1	2nd week	Integrated livestock fish farming infrastructure
4	2	2nd week (1 period) 3rd week (1 period)	Construction materials of integrated livestock-fish farm and constructing an integrated livestock-fish pond
5	2	3rd week (1 period) 4th week (1 period)	Management and maintenance of the integrated livestock - fish infrastructure
6	2	4th week (1 period) 5th week (1 period)	Fish food and fertilisation
7	2	5th week (1 period) 6th week (1 period)	Feeding fishes due to the site of the pond, types of species

8	2	6th week (1 period) 7th week (1 period)	Fish pond enemies and diseases.
9	1	7th week	Fish pond sanitation.

7.8 Unit Summary

Integrated livestock-fish farming is a system of producing fish in combination with other agricultural or livestock farming operations centred around the pond. In this arrangement, fish benefits from the manure from the livestock kept in association with fish rearing. This manure promotes the growth of planktons in the fish pond. Planktons such as algae are the natural foods for fish.

Integrated livestock-fish farming is based on the understanding and exploitation of the existing natural relationships between living organisms in an ecosystem. Integrated fish farming is important for the following reasons:

(i) Economic reasons – To the farmers; it is a way of diversification where there is a continuous supply of income from the sale of fish, farm animals such as rabbit and poultry and from vegetables.

(ii) Environmental reasons – Fish kept in the pond helps to dispose of manure from the animal houses whereas the vegetables can use the waste water drained from the fish pond.

There are different types of livestock – fish integration depending on the type of animals kept in association with fish rearing. Some of these fish farming integration include:

(i) Fish-poultry integration.

(ii) Fish-poultry-vegetable integration.

(iii) Fish-rabbit-vegetables integration.

(iv) Fish-pig integration.

In order for the integrated livestock-fish farming to succeed, the necessary infrastructure must be put in place. These are a fish pond or fish ponds and various shelters for housing the livestock to be kept in combination with fish.

In choosing the materials for the construction of integrated fish farming, the following factors should be put into consideration:

(i) Availability of the materials.
(ii) Cost of the materials.
(iii) Nature of the soil at the selected site.
(iv) Suitability of materials.
(v) Durability of the materials and the strength of the materials.

Materials for the construction of the integrated livestock-fish farming include the following:

(i) Cement, sand and ballast for making concrete.
(ii) Stones, bricks or concrete blocks.
(iii) Timber or wood.
(iv) Corrugated iron sheets or thatch for roofing.
(v) Nails, nuts and bolts, hinges, screws and latches.
(vi) Various wire mesh.

After selecting the construction materials, a suitable site is selected for the construction of the integrated livestock-fish pond. The site is then prepared for the construction of the integrated livestock-fish farming pond. Once the pond is constructed, water is allowed in and fish stocked in the pond. The pond is stocked with young fish known as fingerings from various hatcheries in Rwanda, for example, Kigembe Tilapia Hatchery. Similarly, the appropriate livestock to be kept in association with fish rearing are selected and introduced into the livestock shelters to supply manure for fertilisation of the fish pond.

After the integrated livestock-fish farming has been established, it has to be managed and maintained for the enterprise to succeed. The management and maintenance of an integrated livestock-fish farming infrastructure involves the following practices:

(i) Cleaning up the pond banks.
(ii) Controlling the level and quality of the water in the pond.
(iii) Cleaning the livestock shelters constructed in relation to the fish pond such as aviaries and rabbit hutches.
(iv) Repairing the pond dykes and the livestock structures.
(v) Feeding the fish in the ponds and the animals in the shelters.

Food for the fish reared in ponds include:

- Grain offals
- Herbs
- Concentrates

- Compost
- Livestock dung

The livestock dung is meant for fertilisation of the pond. Fertilisation of the pond refers to the addition of manures or fertilisers to support the growth of planktons, the natural food for fish.

A feeding plan should be made to guide the feeding of fish. This is done for every species of fish in the farm. The feeding plan helps to avoid overfeeding or underfeeding the fish. There are enemies of fish and diseases which may disrupt their growth in the pond.

The enemies of fish include:

- Birds
- Bees
- Nematodes

The diseases of fish include the following

- Cloudy eye
- Columnaris
- Fin rot
- Fungal diseases
- Gill disease
- Hole in the head
- Pop-eye
- Water induced diseases

These diseases cause a lot of damage to fish enterprise and therefore appropriate measures should be taken to control them through various sanitation measures.

The following are the sanitation rules for an integrated livestock-fish pond:

(i) Proper housing and hygiene.
(ii) Cleanliness in and around animal houses.
(iii) Provision of good quality water in the pond.
(iv) Use of antiseptics and disinfectants.
(v) Isolation of sick animals.
(vi) Imposing quarantine.
(vii) Proper nutrition.
(viii) Provision of clean equipment in the animal houses.
(ix) Proper disposal of carcases.

7.9 Additional information for the teacher

Cropping and harvesting of fish.

1. Cropping of fish

This is the removal of only fish of marketable size from the pond. Cropping is done through the following methods:

(a) Hook and line method

In this method baited hooks are lowered into the water for the bait to attract fish. If the fish tries to eat the bait, it gets hooked. The baits used commercially are known as fishing flies. The disadvantages of this method include:

(i) It is slow.
(ii) Young fish which have not attained marketable age may be injured in the process.

(b) Use of nets

Nets of different meshes are used for catching fish. The most common net used in East Africa is the seine net which has meshes measuring 3.0–3.5 cm. The advantages of this method over the hook and line are:

(i) Only the marketable size fish are caught while the smaller ones swim back to the pond.
(ii) Young fish are not injured.
(iii) It ensures a large number of fish are cropped/It is faster.

2. Harvesting

This is the removal of all the fish from the pond. It is done by draining the pond and then removing all the fish. It is carried out as follows:

(i) The inflow of water from the river (source) is stopped by closing the channel leading to the pond.
(ii) The large fish are removed by use of a seine net.
(iii) The outlet is then opened to allow water to flow out.
(iv) A scoop net is used to catch the baby fish known as fingerlings which are kept in a holding pond.
(v) Water is then completely drained out and the pond allowed to dry up.

Note: After draining the pond, maintenance practices are carried out before restocking the pond. After 2–4 weeks the fingerlings are back to the pond by use of scoop nets.

7.10 Suggested Answers to End of Unit 7 Assessment (page 398 of Students' Book)

1. An integrated livestock – fish farming is a system of producing fish in combination with other agricultural or livestock farming operations centred around the pond.

2. (i) Water source – How the water will be brought to the site.
   (ii) The type of soil when building the pond for earth ponds.
   (iii) The size, shape and depth of the pond.
   (iv) The slope of the pond bottom to allow drainage.
   (v) How the pond water may be used for irrigation.

3. The animals kept in association with the fish rearing determines the type of livestock integration. If the livestock is a rabbit then we have a fish-rabbit integration and if poultry are kept in association with fish rearing, we have a fish-poultry integration. If vegetables are grown with the pond water, then we have a fish-poultry-vegetable integration or a fish-rabbit-vegetable integration.

4. (i) Cleaning up the pond banks from all foreign objects.
   (ii) Maintaining the level of pond water at its optimum.
   (iii) Cleaning the livestock structures above or adjacent to the fish pond.
   (iv) Repairing dykes and any other structure around the fish pond.

5 (a) Causal agent of columnaris disease is a bacterium known as Flavobacterium columnare.

(b) Symptoms:
   (i) Frayed and ragged fins.
   (ii) Presence of ulcers/wounds on the skin.
   (iii) Gills change colour by either becoming white or dark brown.
   (iv) Fish breathe rapidly or fast.
   (v) Lack of appetite/Anorexia.
   (vi) Listlessness.

(c) Damage
   Disease has a high death rate where no treatment is given to the fish.

(d) Control:
   (i) Treatment using a combination of antibiotics.
   (ii) Use of medicated fish bath using potassium permanganate and salt.
   (iii) Lowering pond temperature to 24°C.
   (iv) Use medicated food containing antibiotics for internal infections.
   (v) Application of potassium permanganate, copper sulphate or hydrogen peroxide on externally infected fish.
   (vi) Vaccination of fish to prevent outbreak.

6. (a) A – Kingfisher bird
   B – Nematode worm

(b) Parasite – B/Nematode worm
   Predator – A/Kingfisher bird
   A – (i) Cutting down tree/vegetation around the pond.
   (ii) Use of a wire mesh over the fish pond.
   (iii) Scaring.

7. (i) The water temperature should be within an optimum range of 20^{o} C – 26^{o} C
   (ii) Has the correct concentration of dissolved oxygen.
   (iii) Has pH of around neutrality 5.9 – 7.0
   (iv) Has low concentration of nitrogeous compounds such as ammonia nitrites and nitrates.
   (v) Should not have any organic pollutants.

7.11 Remedial activities for the slow learners

1. Name two enemies of the pond.
   (i) Nematode worms
   (ii) Birds
   (iii) Bees

2. What is the natural food for fish?
   Answer
   Planktons.

3. Name three types of food given to the fish.
   (i) Grain offals
   (ii) Herbs
   (iii) Concentrates
   (iv) Compost
   (v) Livestock dung
4. Name three types of integrated livestock-fish farming shelters.

   Answer
   (i) Ponds
   (ii) Aviary/poultry houses
   (iii) Rabbit hutches/Rabbit houses

5. Give four causes of stress in fish.
   (i) Overcrowding
   (ii) Poor quality water
   (iii) Change in diet
   (iv) Irregular feeding.

7.12 Extension activities for gifted and talented learners

1. What is an ecosystem?
   This is a natural community of interacting organisms and their physical environment.

2. State five importance of integrated livestock-fish farming.
   There is increased production of fish meat which is rich in protein.
   Nutrients in animal wastes and spilled feeds are recycled.
   There is maximum use of resources in the farm.
   It reduces the cost of production as resources are well utilised/recycled.
   It acts as a source of income for the small-scale farmers.
   It helps to create jobs.
   There is sustainable resource management.
   It helps to avoid environmental pollution.
3. What is a feed plan?
   It is a schedule or guideline for feeding fish on the basis of species and population of fish.
4. Name two fungal diseases of fish.
   (i) Branchiomycosis.
   (ii) Saprolegniasis.
   (iii) Icthyophonus
5. What is pond sanitation?
   It includes all the routine practices carried out in and around the pond to prevent or reduce the occurrence of diseases and parasites.

7.13 Structure of every lesson

Lesson 1: Importance of the integrated livestock fish farm

Learning objectives

(a) Knowledge and understanding:
   (i) Define and describe the integrated livestock fish farms.
   (ii) Explain the importance of integrated livestock fish farming.

(b) Skills:
   (i) Recognise the integrated livestock fish farming.

(c) Attitudes and values:
   (i) Recognise the integrated livestock fish farm.
   (ii) Take initiative of observing the integrated livestock-fish farms for deducing its importance.

Prerequisites/Revision/Introduction

Teacher asks questions to learners on poultry house and fish species to introduce the lesson.

Teaching Aids

- Integrated fish pond.
- Pictures or charts of integrated livestock-fish farm.

- Different integrated of fish diet.
- Video tapes
- Computer with internet
- Library books.

Learning activities

Research and discussion

Teacher divides the learners into discussion groups. Teacher then instructs the learners to find out the meaning of integrated livestock-fish farming using the references provided. Teacher supervises the group discussions. Learners carry out discussions, record their findings and present their findings to the class. Teacher gives the summary of the lesson.

Teacher divides the learners into discussion groups. Teacher then instructs the learners to find out the importance of integrated fish farms. The teacher supervises the group discussions. Learners carry out discussions, record their findings and present their findings to the class. Teacher gives a summary of the lesson.

Synthesis

The teacher guides the learner to summarises their findings on importance of integrated livestock-fish farming (page 357 – 359 of Student's Book).

Assessment

What is integrated livestock fish farming?

Answer

(i) Proper housing and hygiene – This should ensure that there is no overcrowding and no water pollution.

(ii) Cleanliness – Area around the integrated livestock-fish farming structures should be cleaned and kept free from refuse.

(iii) Provision of good quality water in the pond – This helps to avoid stress related diseases.

(iv) Use of antiseptics and disinfectants – The livestock structures should be disinfected with the recommended disinfectants and detergents to prevent animals from contracting diseases.

(v) Isolation of sick animals – This helps prevent spread of diseases.

(vi) Imposing quarantine – This helps to prevent disease spread.

(vii) Proper nutrition – Correct feeding plan for specific fish species should be used to ensure that the fish are healthy and able to resist diseases.

(viii) Proper disposal of carcasses and waste water – This helps to prevent disease spread.

Lesson 2: Types of integrated livestock fish farms as per animals reared and the features of animal species and breeds reared

Learning objectives

(a) Knowledge and understanding:
  (i) Describe the types of integrated livestock fish farming system.

(b) Skills:
  (i) Find out the types of integrated livestock fish farms.

(c) Attitudes and values:
  (i) Shows concern to the types of integrated livestock

Prerequisites/Revision/Introduction

The teacher introduces the lesson by asking questions on importance of livestock-fish farming to review the previous lesson.

Teaching Aids

- Different ingredients of fish diet.
- Fish farming system.
- Fish ponds lesson by question and answers.
- Internet
- Library books.
- Video, pictures or charts of integrated livestock.

Learning activities

Field trip

Teacher provides a questionnaire as shown in Annex 24 to the learners and instructs them to identify the type of livestock-fish integration practised in the farm visited. Learners observe and identify the livestock-fish integration practised in the farm, record and present their findings to the class. Teacher gives a summary of the lesson.

Synthesis

After learners' discussion and observation, the teacher consolidates them to summarise the types of livestock - fish integration practiced (page 359 – 362 of Student's Book).

Assessment

Name three types of integrated livestock-fish farming shelters.

(i) Ponds

(ii) Aviary/poultry houses

(iii) Rabbit hutches/ Rabbit houses.

Lesson 3: Integrated livestock-fish farming infrastructure
Learning objectives
(a) Knowledge and understanding:
    (i) Explain the condition suitable for the shelter in the integrated livestock farming.
(b) Skills:
    (i) select and gather materials to construct livestock sheds in the integrated fish farming.
(c) Attitudes and values:
    (i) Be concerned by filling matrix and standards.

Prerequisites/Revision/Introduction
The teacher guides the learners to review the lesson on types of livestock-fish integration farming through directive questions.

Teaching Aids
- Notebooks
- Pens
- Integrated livestock-fish farming pond
- Questionnaires
- Video tapes
- Library books.

Learning activities
Field trip
Teacher provides a questionnaire as shown in Annex 25 to the learners and instructs them to observe and identify integrated livestock-fish shelters and find out their construction materials. Learners observe and identify various integrated livestock-fish shelters and their construction materials, record their findings and present their findings to the class. Teacher gives a summary of the lesson.

Synthesis
The teacher consolidates the findings of learners on integrated livestock-fish farming infrastructure (page 362 – 363 Student's Book).

Assessment
Explain how the infrastructure for integrated livestock-fish farming consists.
Answer
The infrastructure for integrated livestock-fish farming consists of the following:
1. A fish pond or fish ponds

A fish pond is a structure used in the rearing of fish. It is filled with fresh water and stocked with fish. The life of a fish depends on water. It provides for the fish's movement, feeding, breathing and resting. Therefore, a fish pond is very important in integrated livestock-fish farming. The fish pond may be constructed separately from other livestock structures or it may be constructed in association with other livestock structures in which case it is referred to as an integrated fish pond.

2. Shelters for housing livestock reared in combination with fish farming.
   The livestock shelters may either be a poultry house, a rabbit hutch or a piggery. These structures may either be constructed over the fish pond(s) or adjacent to the ponds. The structures constructed over the pond should have slatted floors to allow animal droppings to pass through. For structures adjacent to the pond, there should be a mechanism for getting the manure into the pond. Manure from the animal houses is used for fertilisation of the pond.

Lesson 4: Construction of an integrated livestock-fish pond

Learning objectives

(a) Knowledge and understanding:
   (i) Describe the technique of constructing integrated livestock-fish farming.

(b) Skills:
   (i) Construct shelters in the integrated livestock-fish farming.

(c) Attitudes and values:
   (i) be careful in constructing an integrated livestock-fish infrastructure.

Prerequisites/Revision/Introduction

Teacher introduces the lesson by asking learners the question on integrated livestock fish farming infrastructure.

Teaching Aids

- Agriculture S3 Student's Book
- A piece of land/school farm.
- Cement, sand and ballast.
- Fine wire mesh
- Hoes, rakes, hole diggers and slashers.
- Internet
- Iron sheets, thatch
- Library books
- Nails, hinges, latches, bolts and nuts.
- Notebooks
- Pangas, saws and hammers.

- Polyvinyl/Chloride (PVC) pipes (3 inches diameter).
- Stones, bricks and concrete blocks.
- Timber, offcuts
- Video tapes

Learning activities

Discussion: Teacher divides learners into working groups and instructs them to find out the materials used to construct integrated livestock-fish shelters using the references provided. Teacher supervises the group discussions by moving from one group to another. Learners carry out discussions, record their findings and present their findings to the class.

Supervised activity: Teacher divides learners into working groups and provides construction materials/resources for constructing an integrated livestock-fish pond. Teacher instructs the learners to construct the fish pond according to the number of fish and species to be stocked. Learners construct the integrated livestock-fish pond using the materials provided, record their findings and present them to the class. Teacher gives a summary of the lesson.

Synthesis

The teacher finds learners to make a synthesis on construction materials of integrated livestock-fish farm shelters after discussion through reference provided (page 364 – 370 of Student's Book).

Assessment

1. State the factors to consider in selecting construction materials.
2. Explain the procedure of constructing an integrated livestock fish farm.

Answer

Factors to consider:

(i) Availability of the materials.
(ii) Cost of the materials in relation to economic status of the farmer.
(iii) Nature of the soil at the selected site.
(iv) Suitability of each type of material to the prevailing weather conditions.
(v) Durability of the materials.
(vi) Strength of the materials.

Materials required for the construction of these structures include:

(i) Cement, sand and ballast – These materials are needed for making concrete needed for the construction of the pond floor and walls. Concrete is also needed in laying the foundation floor for livestock structures. Cement, sand and ballast are mixed in the ratio of 1:2:3 respectively by volume for the pond floor and walls. Water used in the mixing of these ingredients should be free from soil and other impurities.

(ii) Stones – Quarry stones
These are needed for the construction of the wall of the rabbit and poultry structures. They make durable structures but they are expensive to buy and transport over long distances.

(iii) Concrete blocks – These are made up of cement, sand and ballast in the ratio of 1:2:3 respectively by volume. The amount of water added should be controlled to ensure a mixture which is not very dry or wet. Concrete blocks may be used instead of stone blocks.

(iv) Bricks – They are prepared by using special types of soil with a high amount of clay. The clay is thoroughly puddled with water and moulded in special form boxes to get the desirable shapes and sizes. They are first dried before they are baked in a kiln. The bricks make durable structures if well joined with mortar. They are used in making foundations and walls of the livestock structures.

(v) Timber – This is used for pole rails, trusses, parlins, rafters, struts and the beams in construction work. Sawn timber produces boards of various sizes for floors and fascia boards. If timber is well treated, it produces structures which are resistant to insect damage, weather elements and fungal attack.

(vi) Corrugated iron sheets – They are used for making walls and roofs. They are usually supported on wood frames. Structures made of iron sheets are durable, resistant to insect damage and weather elements. They are also leak proof. However, insulation may be needed to modify temperatures where they are used.

(vii) Thatch – It is used for roofing poultry and rabbit houses. It can be made from coconut leaves or tall grass varieties, papyrus weeds, water weeds, dry banana leaves and bracken ferns. They can be effective roofing materials and good insulators. However, they are prone to insect damage and hence require constant replacement. They are also prone to fire.

(viii) Other materials – Include nails, hinges, screws, nuts and bolts, latches and wire mesh.

Lesson 5: Management and maintenance of the integrated livestock-fish farming.

Learning objectives

(a) Knowledge and understanding:
  (i) Describe the maintenance operations in the integrated livestock fish farming.

(b) Skills:
  (i) Carry out the maintenance operations in a fish pond.

(c) Attitudes and values:
  (i) Be careful in maintaining the integrated livestock-fish farming infrastructure.

Prerequisite/Revision/Introduction

The teacher asks questions on construction of integrated livestock-fish farm shelter as revision of previous lesson.

Teaching Aids

- Aviaries or rabbits hutches
- Aviaries or rubbish hutches.
- Brooms or brushes.
- Buckets
- Fish ponds
- Hand gloves
- Hose pipe
- Library books
- Questionnaires.
- Water

Learning activities

Teaching learners on the field, the teacher forms groups to observe and discuss on maintaining an integrated livestock-fish, infrastructure.

Synthesis

The teacher finds learners while cleaning up the pond and maintain the water level and quality in the pond then after she/he consolidates their practices (page 371 – 372 Student's Book).

Assessment

Explain why water used in fish pond should be of good quality.

Answer

(i) Piece of land.
(ii) Cement, sand, ballast.
(iii) Stone or bricks or concrete blocks.
(iv) Iron sheets or thatch/roofing materials.
(v) Nails, hinges, bolts and nuts.
(vi) Polyvinil Chloride (PVC) pipes.

Lesson 6: Fish food and fertilisation

Learning objectives

(a) Knowledge and understanding:
  (i) List the ingredients of an appropriate diet for fish
  (ii) Define fertilisation of a fish pond.
(b) Skills:
  (i) Select health food for fish reared.
(c) Attitudes and values:
  (i) Participate activity in group discussion and interact positively with colleagues which selecting food for fish.

Prerequisite/Revision/Introduction
The teacher guides learners to review the lesson on maintenance and management of the integrated livestock-fish farm by asking questions.

Teaching Aids
- Computer connected to internet.
- Integrated livestock-Fish farm.
- Notebooks
- Pens
- Questionnaire

Learning activities
Supervised activity: Teacher divides the learners into working groups and instructs them to observe and identify different fish feeds displayed. The teacher asks the learners to prepare a feeding plan for fish based on the number and species of fish reared per pond and to use the plan in feeding fish in the ponds. Learners observe and identify different foods given to the fish, prepare a feed plan for feeding fish and use the plan to feed fish. They then discuss, record and present their findings to the class. Teacher then gives a summary of the lesson.

Synthesis
The teacher guides learners to summarise their findings on fish pond and fertilisation of the pon by giving them as assignment and then consolidate that summary (page 372 – 374 Student's Book).

Assessment
What is pond fertilization?
Answer
Addition of manure or inorganic fertilisers to the fish pond so as to stimulate the growth of planktons, the natural food for fish.

Explain how pond fertilisation is carried out.
Answer
Manure and fertilisers are added to the pond, either directly from the livestock houses or in bags, which are placed into the fish pond floor.

Lesson 7: Feeding fish due to the site of pond, types of species

Learning objectives

(a) Knowledge and understanding:
    (i) Carry out the feeding of the fish
(b) Skills:
    (i) Practice fish feeding
(c) Attitudes and values:
    (i) Observe attentively the food distribution

Prerequisite/Revision /Operation/Introduction

Teacher asks questions to learners on fish pond and fertilisation of the pond to review the previous lesson.

Teaching Aids

- Computer connected to the internet.
- Ingredients of fish pond
- Integrated livestock fish farm
- Notebooks
- Pens
- Questionnaires

Learning activities

Supervised activity: Teacher divides the learners into working groups and instructs them to observe and identify different fish feeds displayed. The teacher asks the learners to prepare a feeding plan for fish based on the number and species of fish reared per pond and to use the plan in feeding fish in the ponds. Learners observe and identify different foods given to the fish, prepare a feed plan for feeding fish and use the plan to feed fish. They then discuss, record and present their findings to the class. Teacher then gives a summary of the lesson.

Synthesis

Through assignment, learners summarise the lesson on feeding fish due to the size of pond and types of species. Then the teacher consolidates that summary given by learners (pages 374 – 376 of Student's Book).

Assessment

What is a feed plan?

Answer

It is a schedule or guideline for feeding fish on the basis of species and population of fish.

Lesson 8: Fish pond enemies and diseases

Learning objectives

(a) Knowledge and understanding:
Identify the names and describe the common diseases of fish.

(b) Skills:
Recognise the fish disease through usable symptoms in the integrated fish farms.

(c) Attitudes and values:
Observe attentively the fish ponds affected by the enemies or diseases

Prerequisite/Revision/Introduction

The teacher introduces the lesson by asking questions on feeding of fish due to the size of pond and types of species to review the previous lesson.

Teaching Aids

- Integrated fish farming
- Internet
- Library books
- Notebooks
- Video tapes or video flash disks
- Video screens, for example, television or laptops

Learning activities

Watching a video on different diseases of fish and their characteristics.

Illustration	Disease	Symptoms	Control measures
1	Columnaris	Frayed fins Ulcers or wounds on the skin Gills turn colour to dark brown Rapid breathing Anorexia	Treat with antibiotics. Dip fish in medicated bath. Reduce pond temperatures to 24 degrees centigrade. Smear infected externally with copper sulphate, or hydrogen peroxide. Vaccination
2	Popeye disease	Protruding eyes Anorexia	Isolate sick fish. Change water and add Epsom salt. Proper feeding with balanced diet. Give antibiotics. Avoid physical damage. Provide healthy pond environment.
3	Cloudy eye disease	Eyes become cloudy or white	Provide antibiotics. Provide proper diet. Dim the lights in the pond.

Synthesis

After being given an assignment on fish pond enemies and diseases, learners' come up with a summary which is going to be consolidated by the teacher (pages 377 – 389 Student's Book).

Assessment

Describe the *branchimycosis* disease of fish by the following items:

- Cause
- Symptoms
- Control

Answer

Cause

This disease is also known as gill-rot disease. It is caused by two fungi; *Branchiomyces sangunis* and *Branchiomyces demigrans*. The fungi thrive in pond water with frequent organic pollutions. The disease is endemic, occurring at certain periods when there is an outbreak. The outbreaks and the duration of the disease depend on the environmental factors, the most important being water temperature. It occurs most frequently when the water is above 20°C with an optimum 26°C. It is associated with low dissolved oxygen concentration, reduced water flow and overcrowding.

It occurs as a secondary infection when the mucus layer of the skin, fins and gills undergo mechanical or chemical injury or damage. The fungal spores are transmitted by water to the gills. The spores adhere to the gills, germinate and produce hyphal.

Symptoms

(i) Reduced movement.
(ii) Difficult breathing.
(iii) The fungus develops on the gill tissue.
(iv) Fish are inactive and are easily caught by hand.
(v) Gills may be appearing red from impaired blood circulation.
(vi) Fish gather in groups at water inlet and die.

Control

- Proper sanitation and disinfection of the area around the pond.
- Burning dead fishes or deeply burying the carcase.
- Drying the ponds with the fungi and treated with quicklime (calcium oxide) or copper sulphate at 2 to 3 kg/ha.
- Sick fish are treated with malachite green.
- Quarantine – restricting movement of fish.
- Increased water supply.
- Removing stressors, for example, regulating pond temperatures and dissolved oxygen concentrations.
- Proper feeding – regulating the feed rate.

Lesson 9: Fish pond sanitation

Learning objectives

(a) Knowledge and understanding:
  (i) Explain a prophylactic plan in the integrated livestock – fish farms.
  (ii) Apply the skills for integrated fish farm sanitation.

(b) Skills:
  (i) Make a prophylactic plan in the integrated fish farming.
  (ii) Practice skills for integrated fish farm sanitation.

(c) Attitudes and value:
  (i) Implement attentively and cautiously the prophylactic plan in an integrated fish farm.
  (ii) Cooperate with colleagues to carry out the sanitation rules.

Prerequisite/Revision/Introduction

The teacher reviews the previous lesson by asking questions related to the fish ponds enemies and diseases guided by photos shown to students.

Learning activities

Supervised activity: Teacher divides the learners into working groups and instructs the learners to carry out fish pond sanitation measures in an integrated livestock-fish farm using the materials provided. Learners carry out the routine practices in an integrated livestock-fish farm, record their findings and present them to the class. Teacher then gives a summary of the lesson.

Teaching Aids

- An integrated livestock-fish pond
- Antiseptics
- Brooms or brushes
- Buckets
- Detergents
- Disinfectants
- Gloves
- Hose pipes
- Pangas/slashers
- Water

Synthesis

The teacher guides learners in carrying out fish pond sanitation by elaborating a routine plan for an integrated livestock-fish farm thereafter she/he consolidates their findings (page 390 – 393 Student's Book).

Assessment

State five pond sanitation rules:

Answer

Pond sanitation rules include the following:

1. Proper housing and hygiene

   Overcrowding in the fish ponds should be avoided. The correct population of fish per pond should be observed according to the various fish species. Livestock shelters over or adjacent to the fish pond should be well constructed and the correct number of animals kept in them. The shelters should have the following structural requirements:

   (a) Well ventilated and free from the cold dry winds.
   (b) Have adequate space for the animals.
   (c) Allow proper drainage and deposition of faecal waste.
   (d) Leak proof.
   (e) Well lit.
   (f) Easy to clean.

   Feeding and watering equipment in the livestock shelters and any other equipment for handling fish should be kept clean.

2. Cleanliness

   The area around the integrated-fish farming structures should be cleared and kept free from refuse. Animal houses and the fish pond should be thoroughly cleaned.

3. Provision of good quality water in the pond

   Ensuring there is good quality water in the ponds helps to avoid stress in the fish, thus controlling environmental diseases. The water should be within the optimum range of temperature, dissolved oxygen concentration, pH and nitrogenous compounds for specific fish species. These should be checked regularly and controlled accordingly. All chemical and physical impurities should be removed from the pond water.

4. Use of antiseptics and disinfectants

   After cleaning, the livestock houses should be disinfected with the recommended disinfectants such as formalin, chlorine, water and detergents. This helps to prevent animals from contracting diseases. Foot baths should be strategically placed at the door of the poultry houses to prevent entry of disease-causing organisms.

5. Isolation of sick animals

   Sick fish should be isolated and kept in hospital tanks where they are given specialised treatment. Sick livestock in the shelters should also be isolated and treated to prevent disease spread.

6. Imposing quarantine

   The movement of livestock and their products from the infected to uninfected

areas should be avoided. This helps to prevent disease spread.

7. Proper nutrition

   Fish should be provided with the correct amounts of feeds. Overfeeding should be avoided as this may lead to pollution of the fish pond. The correct feeding plan for specific fish species such as tilapia, trout, catfish and carp fish should be observed. Similarly, livestock reared in combination with the fish should be well fed and provided with plenty of clean water and mineral supplements in case of rabbits.

8. Proper disposal of carcasses and waste water

   All carcases from sick animals should be burned completely or buried deeply in the soil to prevent spreading of diseases. Water from the ponds should be properly treated before it is released to natural water channels. This is done in stabilisation ponds known as lagoons. The water is treated in these lagoons until it is safe to be discharged to the wetlands.

Unit 8 Co-operative farming

8.0. Key Unit Competence

Learners should be able to explain co-operative farming and its contribution to agro-economic problem-solving in Rwanda.

8.1 Prerequisite Knowledge and skills

Learners should have knowledge in Agricultural Economics, problems and solutions of Agriculture in Rwanda.

8.2 Cross-cutting issue to be integrated in teaching and learning activities

(i) **Gender:** One of the principles of co-operatives is equality. When learners understand this principle they will appreciate and treat one another as equals irrespective of gender (boys and girls).

8.3 Generic competences:

(i) **Critical thinking and problem solving skills** – The case study indicated as problem statement will help learners to think broadly on the problem encountered and come up with possible solutions.

(ii) **Research** – This will help learners to find answers to questions based on used information while searching on the Internet or library books as indicated in all activities of this unit.

8.4 Key terms

1. **Co-operatives:** An organisation of people who have joined together voluntarily with a common purpose for mutual economic benefits.
2. **Co-operatives values:** These are beliefs about what co-operatives consider to be good, right and desirable.
3. **Co-operative principles:** These are guidelines through which co-operatives put their values into action or practice.
4. **Democracy:** Belief in freedom and equality between people in which power is either held by elected representatives of the people or directly by the people themselves.

5. **Equity:** Situation in a society where everyone is treated fairly and equally.
6. **Equality:** The rights of different groups of people in a society to have similar social position and receive the same treatment.
7. **Solidarity:** Agreement between members of a group.
8. **Goal:** The broad aim or purpose of doing something.
9. **Organisation:** A group of people who work together in an organised way for a shared purpose or an arrangement of parts that make a whole.
10. **Organisational objective:** The expected outcome of an organisation's work plan.
11. **Organisational structure:** A formal system of tasks and reporting relationships that co-ordinates and motivates members of an organisation to work together in order to achieve set goals and objectives.
12. **Organisational culture:** A system of shared common values, norms and beliefs of an organisation.
13. **Risk:** Difference or divergence between the expected outcome and the actual outcome of an undertaking or enterprise.
14. **Share:** One of the many equal parts that the ownership of a business organisation is divided into.
15. **Share capital:** A large amount of money and possessions used for starting a new business contributed by members of the business organisation.
16. **Shareholder:** A person who owns shares in a business organisation.
17. **Dividends:** Profit of a business organisation that is paid to the shareholders or people who own shares in it.
18. **Co-operative movement:** A worldwide movement that aims to share profits and benefits from jointly-owned commercial enterprises among members.
19. **Diversification:** Allocating productive resources in several and different enterprises so that should one fail, members benefit from others.
20. **Contract:** A legal agreement between two parties or people to do something.
21. **Insurance:** A legal undertaking by a company to compensate someone or a group of people for losses incurred through theft, fire, accident or injury after regular payments of a certain amount of money known as premium.

8.5 Problem statement: Guidance to the teacher

(a) Divide the learners into groups and instruct them to study the case study provided on page 400 of the Student's Book. They should then carry out the activities listed.

(b) Assist the learners to deduce what should happen to Mr. Kabwoyo if he was a member of the cooperative. The coopeartive should buy his harvest at the market

price or allow him to retail it.

(c) Guide the learners to come up with ways in which people can work together to produce more, these include:
   (i) Uplifting each other financially by pooling their resources together.
   (ii) Increase self-responsibility of each individual.
   (iii) Upholding democratic right which fosters unity and peace.
   (iv) Members appreciate and treat each other equally regardless of gender, social status, religion and race.
   (v) Solidify their common voice when pursuing a certain goal.

8.6 Suggestions for accommodating Special Education Needs (SEN)

When teaching this unit, special education needs learners can be assisted as follows:

	Type of special needs	**Support for the learners**
(i)	**Sensory impairment (visual)**	Use extra-large prints in the instruction sheets and assessment papers. Allow learners to sit near the chalkboard. Pair them with learners with good vision.
(ii)	**Sensory impairment (hearing)**	Be audible enough to the learners. Ask whether they have heard. Allow the learners to sit close to the teacher.
(iii)	**Motor impairment**	Conduct activities in one place to avoid much movement. Pairing them with other learners to assist them in carrying heavy items.
(iv)	**Gifted or talented learners**	Assign them extra tasks. Ask them to assist the slow learners. Place them in different working groups.

8.7 List of Lessons

Lesson No	No. of periods	Weeks	Lesson title
1	1	1st week	Importance and values of cooperative. Types of cooperatives.
2	1		Principles of cooperative. Factors necessary for the success of a cooperative.

8.8 Unit Summary

A co-operative is an organisation of people who have joined together voluntarily for mutual economic benefits. Co-operatives uphold the following values; self-help initiatives, self-responsibility, democracy, equity, equality and solidarity.

Co-operatives are formed to cater for the needs of their members. They are, therefore, categorised on the basis for which they were established. The different types of co-operatives include:

(i) Producer co-operatives.
(ii) Multi-purpose co-operatives.
(iii) Worker co-operatives.
(iv) Worker-shareholder co-operatives.
(v) Consumer co-operatives.
(vi) Marketing co-operatives.

Co-operatives operate on the following principles:

(i) Voluntary and open membership.
(ii) Democratic member control.
(iii) Members economic participation.
(iv) Autonomy and independence.
(v) Education, training and information for members.
(vi) Co-operation among co-operatives.
(vii) Concern for community within which the co-operative is established.

The factors that contribute to the success of co-operatives include organisational structure, culture and risk bearing.

8.9 Additional information for the teacher

When teaching this unit, the teacher should:

(i) Divide the learners into groups and assign them activities.
(ii) Supervise the learners as they carry out the group activities.
(iii) Give the learners adequate time to discuss and report their findings to the class.
(iv) Give summary notes to the learners after the activities as indicated in the Student's Book.
(v) Keep the learners' progressive record and give feedback to the parents.

8.10 Suggested Answers to End of Unit 8 Assessment (page 412 of Students' Book 3)

1. The organisational structure determines how resources are allocated and utilised in the production of goods and services. If the resources are properly utilised there is success and if not, the organisation collapses. A co-operative is an organisation and its success therefore depends on its structure. Co-operatives are democratically run and therefore power lies with the members. The management is accountable to the members and this ensures the success of co-operatives.
2. Producer co-operatives are involved in agricultural production of goods while consumer co-operatives are involved in the selling of farm inputs to the farmers.
3. Profit is the difference between revenue and the cost of production while dividend is the money paid to the shareholders of an organisation out of the profits.
4. Risk is the difference between what is expected and the actual outcome in a business undertaking while uncertainty is the state of not knowing the future.
5. (i) They promote self-help initiatives.
   (ii) They foster self-responsibility.
   (iii) They promote democracy.
   (iv) They enhance equity among members.
   (v) They promote equality among members.
   (vi) They lead to solidarity of the members.
6. Co-operatives are democratically ran on the basis of one-man-one vote basis. The members have equal right. Upon withdrawal of membership, members get back their share contributions. A member may buy shares up to a specific maximum limit in a co-operative. This prevents the domination of the members by one member or a group of members.

8.11 Remedial activities for slow learners

1. Which of the following statements is not true about co-operatives?
   A. They promote self-responsibility
   B. Members can hold as many shares as possible

C. They have concern for the members of the community within which they are established.
D. They operate under the principle of one man one vote.

Answer
B

2. What is the importance of insurance?

Answer
To bear risks of a business undertaking.

8.12 Extension activities for gifted and talented learners

1. Explain how co-operatives control memberships.
   Co-operatives are democratically run on the basis of one man one vote basis. This ensures members have equal rights.
2. (i) What is the function of the co-operative staff?
   To serve members
   (ii) Name the type of:
   (a) Co-operative whose members are engaged in agricultural production.
   Producer co-operatives
   Who hires the senior management of a co-operative?
   (b) Board of directors.
3. What is the meaning of the following terms:
   (a) Share capital – Resources contributed by members of an organisation to start a business.
   (b) Dividend – Profit of a business organisation that is paid to the people who own it.
4. Name the type of co-operative where the workers have shares in the co-operatives.
   Worker– Shareholder co-operatives.

8.13 Structure of every lesson

Lesson 1: Importance and values of co-operation

Learning Objectives

(a) Knowledge and understanding:
   (i) Describe the importance of co-operation in Rwanda and the production growth.

(b) Skills:
   (i) Defend the importance and values of co-operatives using examples.

(c) Attitudes and values
   (i) Appreciate the importance of co-operatives and promise co-operative's values.

Prerequisite/Revision/Introduction

The teacher to divide the class into groups. Teacher then facilitates the learners to identify different types of co-operatives as he/she supervises the group discussion.

The teacher to introduce the lesson by asking the following questions:

- Have you ever worked together with other persons?
- Was it positive or negative? Explain.

Teaching Aids

- Computer room with internet connection.
- Library books.
- Textbooks
- Notebook
- Dictionaries
- Magazines and handbook for co-operatives.

Learning activities

Research and discussion

Teacher divides learners into groups. The teacher then instructs the learners to find out the importance and values of co-operatives in production growth. Using the references provided, the teacher supervises learners' group discussions. Learners give their opinion freely, record and present findings to the class. Teacher to correct any misconception and summarises the lesson.

Teacher divides the class into groups. Teacher then instructs the learners to identify different types of co-operatives with the help of the references provided. Teacher supervises the group discussion. Learners to give their opinion, record and present findings to the class. Teacher to correct any misconception and summarises the lesson and gives notes.

Synthesis

The teacher to summarise the types and importance of co-operatives after the learners' presentation. The teacher provides a summary question to learners and then asks them to discuss on it, thereafter he/she consolidates learner's findings (pages 402 – 404 of Student's Book).

Assessment

Explain how co-operatives provide production growth.

Answer

Co-operatives are democratically run on the basis of one man one vote basis. This ensures members have equal rights.

Lesson 2: Principles of co-operation and factors necessary to the success of a co-operative

Learning objectives

(a) Knowledge and understanding:
  (i) Classify the co-operatives.
  (ii) Explain the principles of co-operatives.

(b) Skills:
  (i) Recognise the types of co-operatives.
  (ii) Defend co-operatives principles.

(c) Attitudes and values:
  (i) Understand the perspectives of co-operatives in problem solving.
  (ii) Be aware of the principles of co-operatives.

Prerequisite/Revision/Introduction

Teachers introduces the lesson by asking learners questions on the importance and values of co-operatives to review the previous lesson.

Teaching Aids

- Resource person to give a talk to the learners.
- Computers with internet.
- Library books.
- Note books and pens.
- Secondary 3 Student's books.
- Questionnaires.

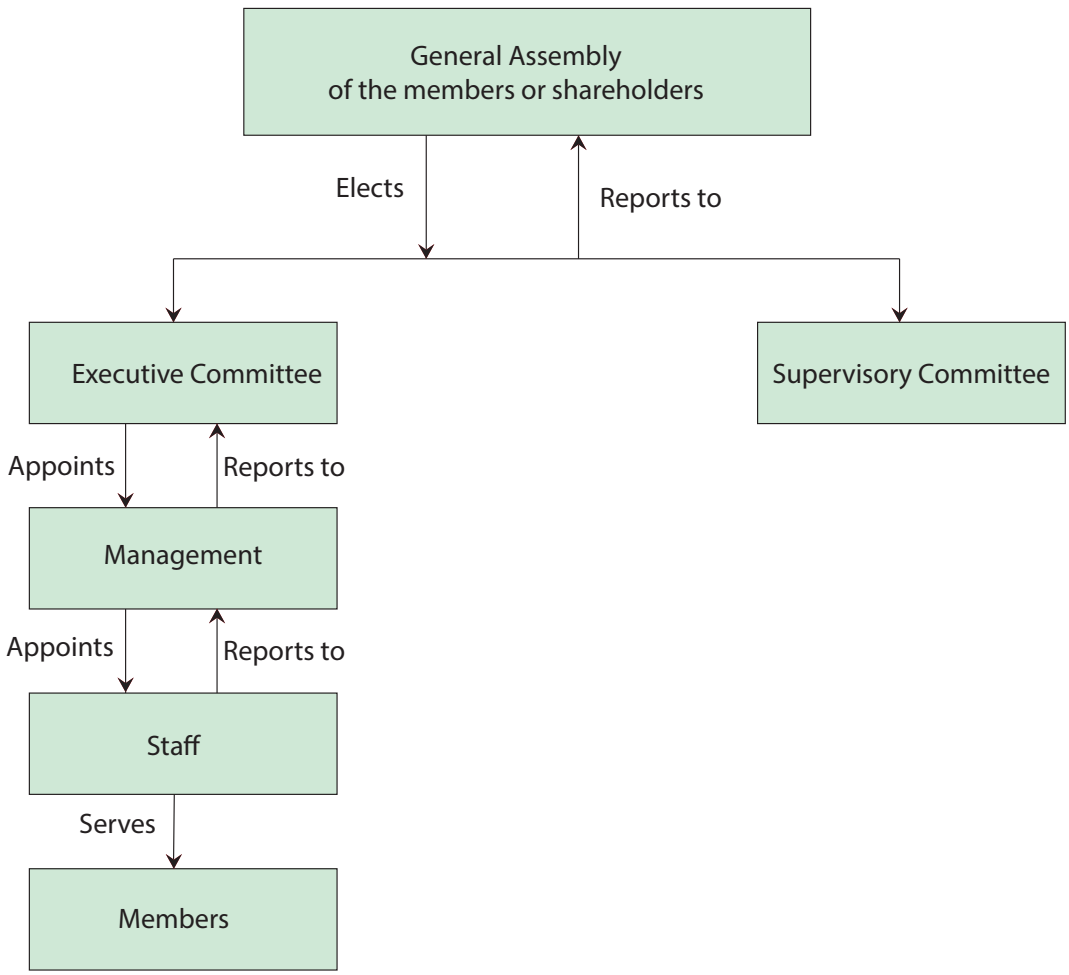
Learning activities

Discussion and research

Teacher divides learners into groups. The teacher instructs the learners to find out the principles of co-operation. Teacher then supervises learners group discussions, record and present findings to the class. Teacher to correct any misconception and summarises the lesson and gives notes.

Teacher divides the learners into groups and then instructs the learners to find out the factors that contribute to the success of co-operatives using the reference materials provided. Learners give their opinion, record and present findings to the class. Teacher concludes the lesson by giving summary notes.

Exercise 8.1
A – Elects
B – Appoints
C – Appoints
D – Serves
E – Reports to



Synthesis
Through an assignment on the principles and factors necessary for the success of co-operatives, learners discuss, come up with a summary and the teacher consolidates the learners' findings (pages 404 – 410 Student's Book).

Assessment
Outline four core values of a co-operative.

Answer

- Honesty – Co-operative members must have ethical value of honesty.
- Openness – Co-operatives belief in open membership irrespective of race, gender or religion.
- Social responsibility – Co-operatives have corporate social responsibility of the people in their community in which they are established.
- Caring for other members of co-operative may concern for one another.

Annex 1

Activity 1.1

A questionnaire for a field visit to observe and find out signs of soil erosion in the area and identify types of soil erosion.

Part I: Administration information:

(i) Name of the farm to be visited: _____

(ii) Name of the visiting institution/school: _____

(iii) Date of travel: _____

(iv) Purpose of the trip: _____

Part II: Leading questions:

1. Who owns the type of land under study?
2. Are there any forests or wood nearby?
3. Are there signs of soil erosions that can be seen?
4. If yes, what type of soil erosion are they?
5. Which type of land are these soil erosion taking place?
6. Describe the type of land used in these areas where soil erosion has taken place.
7. How would you describe the signs that makes you identify the type of erosion seen?
8. What can you attribute these type of soil erosion to?

    - Prepare a written report for discussion.

Prepared by M _____

Agriculture teacher

Annex 2

Activity 1.3

A questionnaire for a field visit to observe and identify causes of soil erosion.

Part I: Administration information:

(i) Name of the farm to be visited: _____

(ii) Name of the visiting institution/school: _____

(iii) Date of travel: _____

(iv) Purpose of the trip: _____

Part II: Leading questions:

1. What type of soil erosion can be said to have taken place here?
2. What would you attribute this type of soil erosion to?
3. What type of soil erosion is found in the areas where the erosion has taken place?
4. Would you say that the type of soil as a factor, has some effects on the erosion?
5. What would you conclude would be the cause of this type of soil erosion?
6. Are there other causes that you can see to have jointly caused these types of soil erosion?
7. If yes, name these other causes of the soil erosion.

    - Prepare a written report for discussion.

Prepared by M _____

Agriculture teacher

Annex 3

Activity 1.7(b)

A questionnaire for a field visit to observe hill sides protected against erosion and to identify cultural measures of soil conservation.

Part I: Administration information:

(i) Name of the farm to be visited: _____

(ii) Name of the visiting institution/school: _____

(iii) Date of travel: _____

(iv) Purpose of the trip: _____

Part II: Leading questions:

1. Are there any areas that you can see where soil erosion has not taken place?
2. Find out why soil erosion has not taken place in these areas.
3. What type of measures have been put in place to control soil erosion in these areas?
4. Observe soil erosion control measure in place, and find out where each control measure is applicable.
5. Find out the type of land use in this area. Does the type of land use contribute to controlling soil erosion or does it accelerate soil erosion?

    - Prepare a written report for discussion.

Prepared by M _____

Agriculture teacher

Annex 4

Activity 1.9

A questionnaire for a field visit to measure contours using an A - frame and a transparent water hose level.

Part I: Administration information:

Name of the farm to be visited: _____

Name of the visiting institution/school: _____

Date of travel: _____

Purpose of the trip: _____

Part II: Leading questions:

1. Observe the type of land where you will measure contours.
2. Is this land flat, gently sloping or steep? If the land is steep, find out what type of soil conservation measures you should take.
3. If the land is gently sloping then you can use the A- frame or the water hose level to the level to measure and mark the contour lines.
4. Use the instructions provided and measure the contour lines.
5. Find out the type of anti-erosive structures that you can make using these contour lines.
    - Prepare a written report for discussion.

Prepared by M _____

Agriculture teacher

Annex 5

Activity 1.10

A questionnaire for a field visit to construct terraces, ridges, bunds and diversion channels.

Part I: Administration information:

(i) Name of the farm to be visited: _____

(ii) Name of the visiting institution/school: _____

(iii) Date of travel: _____

(iv) Purpose of the trip: _____

Part II: Leading questions:

1. Find out the slope of the land and then find out the type of soil conservation structures which should be constructed.
2. Divide yourselves into groups and carry out the following:

   Group I– Carry out the terracing the contour lines measured previously.

   Group II– Carry out ridging along the contour lines measured.

   Group III– Construct a bund along the contour lines.

   Group IV– Construct a diversion channel along the contour line.
3. Which of these constructions are easy to carry out?
   - Prepare a written report for discussion.

Prepared by M _____

Agriculture teacher

Annex 6

Activity 1.11

A questionnaire for a field visit to construct anti-erosive ditches/stone lines:

Part I: Administration information:

(i) Name of the farm to be visited: _____

(ii) Name of the visiting institution/school: _____

(iii) Date of travel: _____

(iv) Purpose of the trip: _____

Part II: Leading questions:

1. Find out the slope of the land where you will construct the anti-erosive ditches and the stoneline.
2. Which type of terrain or slope requires the ditches and which type requires stone-line for soil erosion control?
3. After determining the type of construction to make, determine the contour lines with the A-frame or transparent water hose level.
4. Construct the anti-erosive ditch depending on the type chosen.
5. Construct the stone line.
    - Prepare a written report for discussion.

Prepared by M _____

Agriculture teacher

Annex 7

Activity 1.12

A questionnaire for a field visit to a grass filter strip, a trash line and to construct a gabion or porous dam:

Part I: Administration information:

(i) Name of the farm to be visited: _____

(ii) Name of the visiting institution/school: _____

(iii) Date of travel: _____

(iv) Purpose of the trip: _____

Part II: Leading questions:

1. Find out the type of slope land where you will construct the trash line and grass filter.
2. Mark the contour lines and construct the grass filter, and trash lines along them.
3. Find out whether there is a site where gabions are being constructed by the community and take part in the construction.
4. Some of you can help ferry the stones for gabion construction.

    - Prepare a written report for discussion.

Prepared by M _____

Agriculture teacher

Annex 8

Activity 2.1

A questionnaire for a field visit to explore cultivated cereals and observe their characteristics.

Part I: Administration information:

(i) Name of the farm to be visited: _____

(ii) Name of the visiting institution/school: _____

(iii) Date of travel: _____

(iv) Purpose of the trip: _____

Part II: Leading questions:

1. What are the cereals grown in the farm?
2. What are some the challenges faced in the production of these cereal crops, in terms of pests, diseases, market?
3. What is the market for the cereal grown in the farm?
4. Why did you decide to plant cereal crops and not other crops?
5. Apart from the cereal crop growing, what other agriculture activities are carried out in the farm?

    - Prepare a written report for discussion.

Prepared by M _____

Agriculture teacher

Annex 9

Activity 2.5

A questionnaire for a field visit to conduct the cultural practices of rice.

Part I: Administration information:

Name of the farm to be visited: _____

Name of the visiting institution/school: _____

Date of travel: _____

Purpose of the trip: _____

Part II: Leading questions:

1. What are the varieties of rice grown in this farm/field?
2. What method of irrigation is carried out in the farm/field.
3. Explain how the following cultural practices of rice are carried out.
   (i) Nursery preparation and management
   (ii) Transplanting
   (iii) Control of water level in the field
   (iv) Control of pests and diseases
   (v) Harvesting of rice
4. What are some of the challenges faced in the growing of rice and how are they overcome?
5. What is the market for the rice grown in the farm?

   • Prepare a written report for discussion.

Prepared by M _____

Agriculture teacher

Annex 10

Activity 3.2

A questionnaire for a field visit to explore and observe ornamental plants grown in Rwanda.

Part I: Administration information:

Name of the farm to be visited: _____

Name of the visiting institution/school: _____

Date of travel: _____

Purpose of the trip: _____

Part II: Leading questions:

1. What are some of ornamental plants grown in the farm?
2. What some of the factors that led to the choice of ornamental plants grown in this farm?
3. What are uses of the ornamental plants grown in the farm?
4. What is the market for the cut-flowers grown in the farm local or foreign? If foreign market, how are the flowers transported to the airport?
5. What is the source of the seedlings for the ornamental plants grown in the farm?
6. What are the source of water used in the farm?
7. What are some the challenges faced in the farm? How are these challenges overcome?

    - Prepare a written report for discussion.

Prepared by M _____

Agriculture teacher

Annex 11

Activity 3.5

A questionnaire for a field visit to conduct the cultural practices for Roses.

Part I: Administration information:

(i) Name of the farm to be visited: _____

(ii) Name of the visiting institution/school: _____

(iii) Date of travel: _____

(iv) Purpose of the trip: _____

Part II: Leading questions:

1. What are some of the varieties of Roses grown in the farm?
2. What factors led to the choice of Rose varieties grown in the farm?
3. Explain briefly how the following cultural practices of Roses are carried out.
   (i) Transplanting/planting
   (ii) Pruning
   (iii) Fertilisation
   (iv) Watering
   (v) Mulching
   (vi) Weed control
   (vii) Pest management
   (viii) Pest control
   (ix) Harvesting
4. What is the source of the water used for irrigation in this farm?
5. What are some of the challenges faced in the growing of Roses?
6. What is the market for Roses grown in the farm?
7. How are the Roses transported to the airport for export market?
   - Prepare a written report for discussion.

Prepared by M _____

Agriculture teacher

Annex 12

Activity 3.6

A questionnaire for a field visit to conduct cultural practices of Duranta and Palm trees.

Part I: Administration information:

(i) Name of the farm to be visited: _____

(ii) Name of the visiting institution/school: _____

(iii) Date of travel: _____

(iv) Purpose of the trip: _____

Part II: Leading questions:

1. What are the varieties of Duranta and Palm trees grown in the farm?
2. What are the use(s) of the Duranta plants and Palm trees grown in the farm?
3. Briefly explain how the following cultural practices of Duranta and Palm trees are carried out.
   (i) Establishing/planting
   (ii) Pruning
   (iii) Fertilisation
   (iv) Watering
   (v) Mulching
   (vi) Weed control
   (vii) Pest management
   (viii) Disease control
4. What is the source of water used in the farm?
5. What are some of the challenges faced in the growing of Duranta and Palm trees?

- A field trip may be just to the neighbouring farm or school.
- Prepare a written report for discussion.

Prepared by M _____

Agriculture teacher

Annex 13

Activity 3.7

A questionnaire for a field visit to conduct the cultural practices of Anthurium.

Part I: Administration information:

(i) Name of the farm to be visited: _____

(ii) Name of the visiting institution/school: _____

(iii) Date of travel: _____

(iv) Purpose of the trip: _____

Part II: Leading questions:

1. What are the varieties of anthurium grown in the farm?
2. What are the uses of anthurium grown in the farm?
3. Are anthurium grown as indoor plants or for cut-flower?
4. Briefly explain the following cultural practises of anthurium.
   (i) Planting
   (ii) Pruning
   (iii) Fertilisation
   (iv) Watering
   (v) Weed control
   (vi) Mulching
   (vii) Disease control
   (viii) Pest management
   (ix) Harvesting
5. What is the source of water used for irrigation in the farm?
6. What are some of the challenges faced in the growing of anthurium in the farm?

- Prepare a written report for discussion.

Prepared by M _____

Agriculture teacher

Annex 14

Activity 3.8

A questionnaire for a field visit to conduct the cultural practices of Bougainvillea.

Part I: Administration information:

(i) Name of the farm to be visited: _____

(ii) Name of the visiting institution/school: _____

(iii) Date of travel: _____

(iv) Purpose of the trip: _____

Part II: Leading questions:

1. What are the varieties of Bougainvillea grown in the farm?
2. What are the uses of the Bougainvillea grown in the farm?
3. Explain briefly the following cultural practices of growing Bougainvillea?
   (i) Establishment/planting
   (ii) Pruning
   (iii) Fertilisation
   (iv) Watering
   (v) Weed control
   (vi) Mulching
   (vii) Disease control
   (viii) Pest management
   (ix) Harvesting
4. What is the source of water used for irrigation in the farm?
5. What are some of the challenges faced in the growing of Bougainvillea in the farm?
   - Prepare a written report for discussion.

Prepared by M _____

Agriculture teacher

Annex 15

Activity 4.2

A questionnaire for a field visit to explore fodder grasses cultivated around the school.

Part I: Administration information:

(i) Name of the farm to be visited: _____

(ii) Name of the visiting institution/school: _____

(iii) Date of travel: _____

(iv) Purpose of the trip: _____

Part II: Leading questions:

1. What are the fodder crops grown in the farm?
2. How are the fodder grasses grown in the farm utilised?
3. Briefly explain the following cultural practices of any one of the fodder grasses grown in the farm (Nappier, Guatemala, Sorghum).
   (i) Establishment/planting
   (ii) Weeding
   (iii) Harvesting
4. Explain briefly the conservation of Nappier in the form of silage.
5. Explain briefly the conservation of Guatemala in the form of hay.
6. Are all the fodder grasses grown utilised in the farm or some are sold to earn income? If yes, explain.
7. What are some of the challenges of growing the fodder grasses in the farm?
   - Prepare a written report for discussion.

Prepared by M _____

Agriculture teacher

Annex 16

Activity 5.4

A questionnaire for a field visit to an Apiary to observe and find out different categories of bees and their characteristics.

Part I: Administration information:

(i) Name of the farm to be visited: _____

(ii) Name of the visiting institution/school: _____

(iii) Date of travel: _____

(iv) Purpose of the trip: _____

Part II: Leading questions:

1. Observe the Apiary and the arrangement of the hives in it.
2. Find out the reason why the Apiary is sited where it is.
3. Find out the categories of bees in a colony in one of the hives.

   Note: This should be done for you by a qualified beekeeper who should be well dressed for the practice. The beekeeper will separate the bees from the hive and bring them in a glass container outside to a safe place.

4. Find out the differences between the categories of bees and their functions in the hive.

   - Prepare a written report for discussion.

Prepared by M _____

Agriculture teacher

Annex 17

Activity 5.7

A questionnaire for a field visit to observe beehive and carry out bee management.

Part I: Administration information:

(i) Name of the farm to be visited: _____

(ii) Name of the visiting institution/school: _____

(iii) Date of travel: _____

(iv) Purpose of the trip: _____

Part II: Leading questions:

- Only three learners should enter Apiary while fully dressed in a protective kit and with a smoker. The rest should stay outside at a safe distance quietly to watch the three as they carry out the following:

5. Approach the hive from behind or the side as you carry a smoker.
6. Use the smoker to protect yourself.
7. Open the hive and inspect the honey by lifting the top bars starting with the one at the far end.
8. Puff the smoke through the top bar before lifting them.
9. Harvest the ripe honey. Make sure not to carry any bees together with the honey.
10. Cover the hive and carry the honey and leave after cleaning the area.

- Prepare a written report for discussion.

Prepared by M _____

Agriculture teacher

Annex 18

Activity 5.8

A questionnaire for a field visit to carry out honey harvesting.

Part I: Administration information:

(i) Name of the farm to be visited: _____

(ii) Name of the visiting institution/school: _____

(iii) Date of travel: _____

(iv) Purpose of the trip: _____

Part II: Leading questions:

1. Make sure you put on a safety kit and carry a smoker.
2. Find out the types of beehives in the Apiary
3. Are there any top bar hives? These are known as movable comb hive and are easy to handle.
4. About three learners will enter the Apiary while dressed in protective kit together with the beekeeper. The rest of the learners will watch from a safe distance quietly as instructed.
5. Carry out the harvesting practices after inspecting the hive.
    - Prepare a written report for discussion.

Prepared by M _____

Agriculture teacher

Annex 19

Activity 6.1

A questionnaire for a field visit to observe Aviary and Pigsty and their standards.

Part I: Administration information:

(i) Name of the farm to be visited: _____

(ii) Name of the visiting institution/school: _____

(iii) Date of travel: _____

(iv) Purpose of the trip: _____

Part II: Leading questions:

1. Find out what Aviary and Pigsty are.
2. Find out their sizes and how this relates to the number of livestock kept in the structures.
3. Find out the features of both Aviary and Pigsty. How do these features relate to the ability to give security, warmth and comfort to the birds and pigs?
4. Observe the materials they are made of and comment on:
   (i) Durability
   (ii) Cost
   (iii) Suitability to the animals being housed
5. How are the materials fitted and how many compartments are there in the Pigsty? Find out the what these compartments are used for, what they are called and why?

   • Prepare a written report for discussion.

Prepared by M _____

Agriculture teacher

Annex 20

Activity 6.4

A questionnaire for a field visit to observe feeding of non-ruminants, Poultry and Pigs.

Part I: Administration information:

(i) Name of the farm to be visited: _____

(ii) Name of the visiting institution/school: _____

(iii) Date of travel: _____

(iv) Purpose of the trip: _____

Part II: Leading questions:

1. Find out the types of feeds given to Pigs and Poultry? Are they of vegetable materials?
2. Do these animals Poultry and Pigs eat the same type of food?
3. What is the frequency of feeding these animals? Are they the same for both Poultry and Pigs?
4. Are these animals fed according to type and age? Do they adapt the same feeding practices?
5. What types of feeds are given to the following groups:
   (a) The young of both Pigs and Poultry.
   (b) The weaning Pigs and growing Poultry.
   (c) The adults of Pigs and Poultry.

- Prepare a written report for discussion.

Prepared by M _____

Agriculture teacher

Annex 21

Activity 6.10

A questionnaire for a field visit to observe Pig diseases and enemies.

Part I: Administration information:

(i) Name of the farm to be visited: _____

(ii) Name of the visiting institution/school: _____

(iii) Date of travel: _____

(iv) Purpose of the trip: _____

Part II: Leading questions:

1. What are the common diseases and parasites that affect Pigs in this farm?
2. Are the diseases common in the area, and around Rwanda?
3. What are the symptoms of each of the diseases?
4. What are the economic implications of these disease attacks?
5. Are there any diseases and parasites that can be transmitted to human beings from the Pigs?
6. Are there diseases that require the whole country to be notified? **Note**: Such diseases are referred to as Notifiable diseases.
7. What are the prevalent Pig diseases in this area?

- Prepare a written report for discussion.

Prepared by M _____

Agriculture teacher

Annex 22

Activity 6.9

A questionnaire for a field visit to make observations on Poultry diseases.

Part I: Administration information:

(i) Name of the farm to be visited: _____

(ii) Name of the visiting institution/school: _____

(iii) Date of travel: _____

(iv) Purpose of the trip: _____

Part II: Leading questions:

1. What are the common diseases in the farm?
2. Briefly explain the common diseases in the farm (Newcastle, Pulorum, Coccidiosis, Mycotovicosis and Marek's disease) in terms of:
   (i) Causal organism
   (ii) Symptoms
   (iii) Control measures
3. What are some of the challenges faced in the keeping of livestock in the farm other than diseases?
4. What prophylactic measures are carried out in the farm to prevent disease spread?

- Prepare a written report for discussion.

Prepared by M _____

Agriculture teacher

Annex 23

Activity 6.12

A questionnaire for the field visit to carry out farm sanitary in Poultry and Pig houses.

Part I: Administration information:

- Name of the farm to be visited: _____
- Name of the visiting institution/school: _____
- Date of travel: _____
- Purpose of the trip: _____

Part II: Leading questions:

1. What are the sanitation rules for the Poultry and Pig houses in the farm?
2. Find out the daily activities that are carried out in the farm to ensure proper sanitation.
3. Are there any disease outbreaks that have been experienced in the farm? If yes, what would you attribute these outbreaks to?
4. How does the farm carry out practices that can keep off diseases? Are there any strict restrictions to unauthorised person entering the farm?
5. How does the farm dispose of human refuse, animal carcasses, manure and chemical containers which can be a source of infection?

    - Prepare a written report for discussion.

Prepared by M _____

Agriculture teacher

Annex 24

Activity 7.3

A questionnaire for the field visit to an integrated livestock-fish farm to observe types of integrated fish farming systems.

Part I: Administration information:

(i) Name of the farm to be visited: _____

(ii) Name of the visiting institution/school: _____

(iii) Date of travel: _____

(iv) Purpose of the trip: _____

Part II: Leading questions:

1. What system(s) of livestock-fish farming is practised in the farm?
2. Other than the rearing of fish, what are other farming operations carried out in the farm? What is the relationship between the fish reared in ponds and the livestock kept in the farm? Explain.
3. What is the source of water used for fish rearing in the pond?
4. Is the water in the pond used in any other way other than rearing the fish?
5. What are some of the challenges faced in the rearing of fish in the integrated livestock-fish farming? How are these challanges overcome?

- Prepare a written report for discussion.

Prepared by M _____

Agriculture teacher

Annex 25

Activity 7.4

A questionnaire for the field visit to an integrated livestock-fish farm to observe and identify integrated livestock-fish shelters and their construction materials.

Part I: Administration information:

(i) Name of the farm to be visited: _____

(ii) Name of the visiting institution/school: _____

(iii) Date of travel: _____

(iv) Purpose of the trip: _____

Part II: Leading questions:

1. What are the shelters used in the farm for the integrated livestock-fish farming?
2. What are the materials used in the construction of the livestock shelters for the integrated livestock-fish farming?
3. What is the source of the construction materials used in the livestock shelters?
4. How are the materials treated before being used for constructing the livestock-fish farming structures?
5. What are the challenges faced in the farm and how are these challenges overcome?

    - Prepare a written report for discussion.

Prepared by M _____

Agriculture teacher

Annex 26

Activity 7.8

A questionnaire for the field visit to an integrated livestock-fish farm to observe fish food and fertilisation of fish ponds.

Part I: Administration information:

(i) Name of the farm to be visited: _____

(ii) Name of the visiting institution/ school: _____

(iii) Date of travel: _____

(iv) Purpose of the trip: _____

Part II: Leading questions:

1. What do the fish in the ponds eat?
2. From where do you get food for the fish?
3. What are some of the commercial feeds that are grown for the fish in the ponds?
4. What is the importance of giving herbs to the fish?
5. What is the purpose of adding manure to the fish pond?
6. How is the livestock dung added to the pond?
7. What other substance is added to the pond for fertilisation?

- Prepare a written report for discussion.

Prepared by M _____

Agriculture teacher

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