FACILITATOR GUIDE

Conservation

Level 2

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Title:		**Apply Sustainable Farming Practices to Conserve the Ecological Environment**					
Applied Title:		**Apply Sustainable Citrus Farming Practices to Conserve the Ecological Environment**					
Field:		Agriculture and Nature Conservation					
Sub-Field:		Primary Agriculture					
SETA (SGB):		AgriSETA					
Skills Area:		Conservation					
Context:		Citrus Production					
US No:	116121	**Level:**	2	**Credits:**	5	**Notional Hours:**	50
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Directions

1. Learning Material

This guide has developed to assist the facilitator in presenting this unit standard. The guide contains all necessary material to ensure that the facilitator will be able to assist the learner to attain the competencies required by the unit standard.

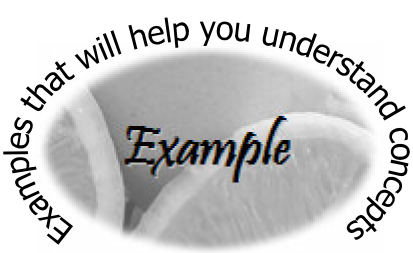
This set of learning material consists of the following guides:

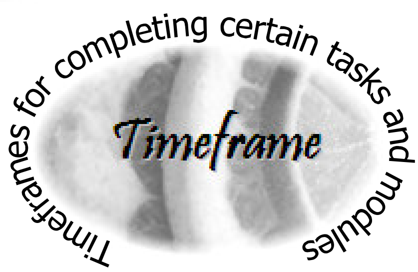
- ***Learner guide*** that contains all the information required by the learner to attain competency in this unit standard
- ***Facilitator guide*** that is a copy of the learner guide but contains additional instructions for the facilitator.
- ***Assessment Guide for Assessors and Facilitators*** that contains all the documentation needed by the assessor and facilitator to assess the competency of the learner against this unit standard.
- ***Assessment Guide for Learner and Learner Workbook*** that contains the documentation required by the learner to complete the assessment, along with the worksheets and practical exercises that the learner needs to complete as part of the formative assessment.

Please ensure that you are familiar with the contents of all of these guides before presenting this unit standard.

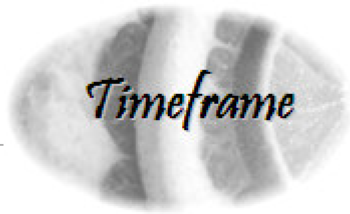
Although the learner and facilitator guide contains all the information required for attaining competency in this unit standard, references to additional resources (both printed and electronic) are provided for further study by the learner.

Information in boxes is indicated by tags that show:





2. Learning Program Timeframe



This is a summary of the timeframe for this learning program. You will be reminded of the time allowed for each module as you work through the guide.

Process	*Total Allocated Time*	*Theoretical Learning*	*Practical Learning*	*Activities*
Complete Program (Including summative assessment)	**50h**	**21h 45min**	**28h 15min**	**6**
Learner Orientation and Ice Breaker	30min	15min	15min	n/a
Purpose, Introduction and Learner Directions	30min	15min	15min	n/a
Introduction to Citrus Production	45min	30min	15min	n/a
Session 1 (Chapter 1)	9h	4h 30min	4h 30min activities	1-3
Session 2 (Chapter 2)	5h	5h		
Session 3 (Chapter 3)	5h	3h 30min	1h 30min activities	4
Session 4 (Chapter 4)	5h	3h 30min	1h 30min activities	5
Session 5 (Chapter 5)	21h 30min	3h 30min	3h activities 15h work constructing firebreaks	6
Preparation for Assessment and Revision	2h 45min	45min	2h	n/a

3. Technical Program Specifications

Format	Programmed instruction workshop, combined with structured internship format as prescribed for learnership, skills program or short course.
Target Learner Description	A typical level 2 learner has functional numeracy and literacy skills, but a minimal level of experience. **EE Ratios:** 1 Male:1 Female 8 PDI:2 W 1 Employed:1 Unemployed
Articulation Options	Nil formal in place
Delivery Mode	A combination of small group mode and individual mode

Training Method and Activities	**Program Instruction:** This program forms part of an apprenticeship where coaches provide practical training in the fields requiring functional competency. The theoretical study section of the training is conducted as a 4-day workshop in the Cohort group format. Additional training activities include buzz groups, rotating roll plays, simulations, games and brainstorming sessions, and group discussions.
Learner Support Strategies	Learners are inducted by "explore strategies to learn program". Learners are supplied with all resources and aids as required by the program, including: • Objects and devices such as equipment • Manuals and guides • Visual aids

Facilitator Tip

This unit standard is aimed at level 2 learners.

- A typical level 2 learner might only have been exposed to the working world for a short time.
- Explain concepts and define words in a simple, clear and concise manner throughout the learning program to help the learner where possible.
- Take special care to facilitate for ALL learners. Allow them opportunities to share experiences, prior knowledge, translate into their mother tongue for each other, and enjoy the learning process.
- The examples given in this resource guide might be for a different geographical area or commodity to what the learner is exposed to. Please adapt your examples according to the learning context.

4. Facilitator's Checklist

Facilitator Tip

This checklist has been designed to assist you in delivering the best possible facilitation to the learners.

Please use it and supply whatever resources you might have in short supply at your venue of learning.

Preparation	***Yes***	***No***
Content Knowledge I have sufficient knowledge of the content to enable me to facilitate with ease.		
Application Knowledge I understand the program matrix and have prepared for program delivery accordingly.		
Ability to Respond to Learners Background and Experience I have studied the learner demographics, age group, experience and circumstances, and prepared for program delivery accordingly.		

Preparation	***Yes***	***No***
Enthusiasm and Commitment I am passionate about my subject and have prepared my program delivery to create a motivating environment with real commitment to success.		
Enterprise Knowledge I know and understand the values, ethics, vision and mission of the Citrus Academy and the service provider under whose auspices the program will be conducted, and have prepared my program delivery, reporting and administrative tasks accordingly.		
Equipment Checklist:		
Learner Guides: 1 per learner		
Learner Assessment Guides: 1 per learner		
Writing material and stationery for facilitator and learner		
White board and pens		
Flip chart paper		
Proxima projector and screen		
Notebook computer and program disk		
Documentation Checklist:		
Attendance register		
Course evaluation		
Learner course evaluation		
Portfolios of evidence		

5. <u>Proposed Floor Plan</u>

No floor plan is prescribed for this training module.

Introduction

1. Purpose

A learner achieving this unit standard will be able to explain the importance of maintaining and increasing natural resources. Furthermore, the learner will be able to incorporate this understanding into existing farming activities by applying basic practices to conserve the environment, including natural resources.

Competent learners will be familiar with the most important agricultural regulations and aspects of conservation as to provide the environment for the application of quality practices and thus strengthen agricultural practices in general.

Learners will gain an understanding of sustainable agricultural practices as applied in the animal-, plant and mixed farming sub-fields. The application of natural resource management in primary agriculture is focussed on in this unit standard.

They will be able to participate in, undertake and plan farming practices with knowledge of their environment. A culture of maintenance and care will be instilled for both the environment as well as towards farming infrastructure and operations by this unit standard.

2. Learning Assumed to Be in Place

It is assumed that the learner has successfully completed the unit standards listed below:

NQF Level	***Unit Standard Number***	***Unit Standard Description***
1 (ABET 4)	Literacy and Numeracy	
1	116169	Understand how sustainable farming systems conserve natural resources

It is important to ensure that the learners who are undertaking this learning program has already completed the correct prior learning modules, to ensure that they are not unfairly disadvantaged by the learning process, and can be supported accordingly.

Do not forget to complete the Diagnostic Assessment (Step 3 in the Assessment Guide).

Introduction to Citrus Production

Timeframe

You have to complete this section as follows:

Total time	***Theory***	***Practical***
45min	30min	15min

Facilitator Tip

While this section does not form part of the unit standard as such, it is essential for the learner's orientation to the learning context. Please take time to ensure that the learners have a thorough understanding of this section.

1. Introduction

This learning material has been developed in the context of citrus production, which means that the skills area is dealt with in terms of and as applied to citrus production. To help the learner place the material in the right context, it is necessary for the learner to understand the background to citrus production, and the manner in which a citrus plant produces fruit.

2. Background

Citrus originates from the subtropical regions of south-east Asia. In the wild, citrus trees in these regions produce fruit all year round, and the fruit are small, poorly coloured and blemished. In the absence of effective production practices, citrus trees do not produce fruit suitable for the market.

Citrus production is largely concerned with management of the practices and processes that manipulate the tree to produce high yields of marketable fruit. Production management, together with the selection of superior varieties and plant improvement, can be seen as an on-going effort to influence the natural tendencies of the tree.

Consumers want the fruit of their choice to be available at all times. Fruit should look good, be unblemished, well-coloured (superior exterior quality), taste good (high interior quality) and be of the right size. At the same time, the citrus producer wants orchards that will provide high yields over an orchard lifespan of 18 to 30 years. On top of all this, the citrus orchard must be managed in such a way that production practices have the least possible impact on the natural environment. Commercial citrus production management is about achieving these objectives efficiently and cost effectively.

3. Citrus Planting

Citrus trees are planted in rows in orchards. The planting distance, also called tree spacing or espacement, between rows and between trees within rows, is determined by numerous factors including climate, variety, and soil type. A typical tree spacing is 6m between rows by 3m between trees, meaning that 555 trees per hectare (ha) are planted (1ha = 10,000 m^2).

Once planted, trees take three or more years before bearing fruit that can be marketed. Thereafter, per tree and per hectare yields steadily increase to 40 to 70 t/ha – depending on cultivar and variety – after a further 4 to 7 years. If the trees are well looked after, this level of production will remain fairly constant until trees start to decline naturally.

Definition

Yield

Yield refers to the amount of fruit produced, and can be expressed in terms of:

Tree yield	kg per tree	kg/tree
Orchard yield	tons per hectare	t/ha
Export yield	15kg carton equivalents per hectare	cartons/ha
(10kg carton equivalents for soft citrus)		

4. Lifespan

The average economic lifespan of a commercial citrus orchard varies between 18 and 30 years, and can be as high as 30 to 60 years in hot, dry areas. Citrus is therefore viewed as a long-term crop. For citrus production to be profitable, the orchard must produce high yields of quality fruit every year, and do this consistently over a long period of time.

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In citrus production the challenge is therefore to make production decisions and take actions to ensure high annual production of marketable fruit, while ensuring that these decisions and actions contribute to the long-term sustainability of the orchard.

5. Citrus Plant Phenology

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Facilitator Tip

This is a difficult concept for level 2 learners and should be handled with care and extra attention.

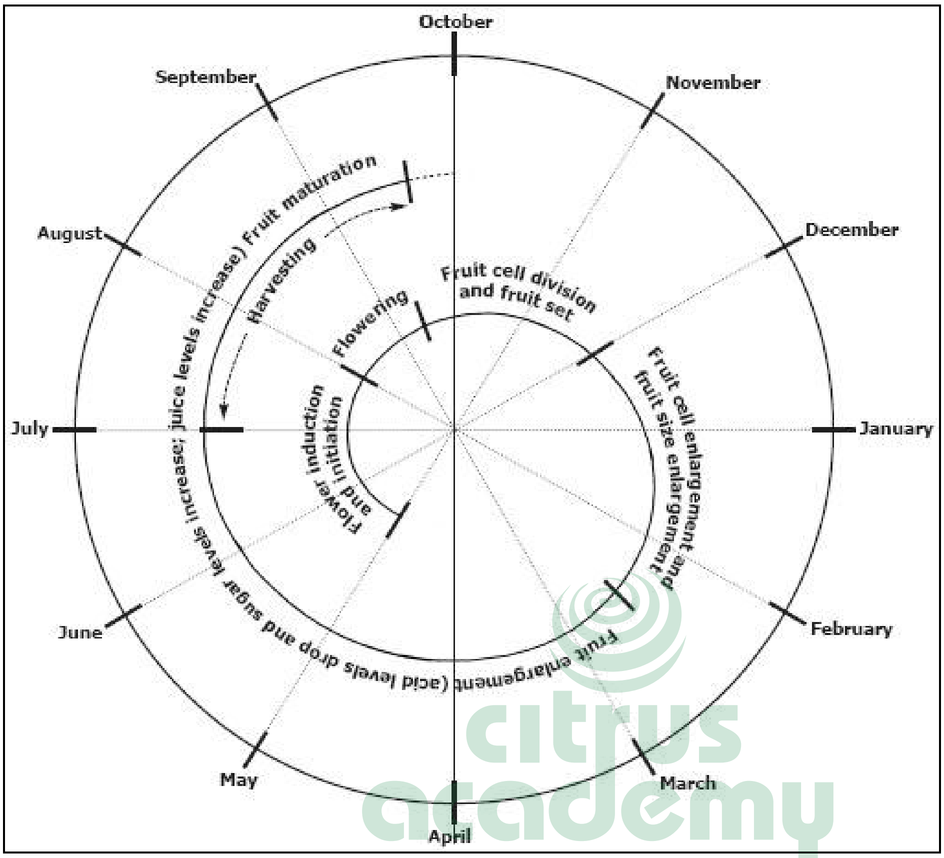
Definition

Phenology

Phenology refers to regularly recurring biological phenomena and the environmental and climatic factors that influence them. In citrus, phenology specifically refers to the annual cycle of the citrus tree.

Understanding the phenology of the citrus tree is essential to understanding the reasoning behind many of the practices and actions employed in citrus production. For example, the timing of fertiliser applications is linked to the phenology of the tree, with most fertilisers being applied at appropriate times to optimise flowering, fruiting, fruit development and fruit maturation.

The figure and table below set out the annual cycle of the citrus tree with regard to fruit production. Please note that this figure and table reflect the approximate flower and fruit development cycle of a valencia orange tree, and that the phenology of various cultivars differ.



Stage	*Description*	*Time Period*
Flower Induction and Initiation	Flower initiation is the induction and differentiation of vegetative buds into flower buds at a cellular level, and cannot be seen with the naked eye.	May to July
Flowering	Flowering or "bloom" is when blossoms appear on the tree.	August to Mid-September
Cell Division and Fruit Set	Cell division is the period when cells making up the fruit increase in number. Fruit set is the period from flowering or "bloom" until the end of fruitlet drop, after which the final fruit load is determined.	Mid-September to November
Cell Enlargement and Fruit Growth	Cell enlargement is the period during which cells making up the fruit increase in size. Fruit growth is the period during which the fruit grows and develops.	December to Mid-February
Fruit Maturation and further Fruit Growth	During this period fruit enlarges further and matures internally, meaning that the flavour, sugars and acids reach their optimum levels.	Mid-February to September
Harvest		July to September

It is important to note the term **citrus season** refers to the period from when flower initiation begins to the harvest. The season is generally from the beginning of August of one year to the end of July of the next year, although harvesting may extend to September and October for late cultivars.

6. Citrus Learning Material

The following citrus specific learning material is available from the Citrus Academy:

Skills Area	***Description***
Enterprise Selection, Planning and Establishment	Concerns itself with identifying the various components of an agricultural enterprise, and with the selection and planning processes for a new enterprise, and looks at the physical layout of a farm, with specific reference to infrastructure, orchard layout, etc.
Propagation	Concerns the various methods and requirements for the multiplication of plant material of specific varieties that possess desired qualities.
Crop Establishment	Concerns the establishment of a new citrus orchard, in terms of the physical planting of trees and the care for young trees.
Plant Structures and Functions	Considers the structure and function of various plant parts and the manner in which nutrients, water, air and sunlight is taken up and processed.
Plant Nutrition and Soil Management	Concerns itself with plant nutrients, in terms of the requirements of the citrus plant and the supplementation of nutrient elements through fertilisation, with specific reference to the timing and manner of application.
Water Quality	Considers the various factors that influence water quality and manners in which water quality can be measured and controlled. Considers furthermore the effect of water quality on tree and fruit growth and development, in combination with effective irrigation, fertilisation and pest control.
Plant Manipulation	Concerns various types of physical and chemical plant manipulation, with specific reference to pruning, girdling and the application of plant growth hormones, and tools and equipment used for this purpose.
Irrigation	Looks at the technical aspects of orchard irrigation, with reference to the types of irrigation systems, the installation of new irrigation systems, and the repair and maintenance of an irrigation system. Also concerns irrigation scheduling, and measures to ensure effective irrigation.
Pests, Diseases and Weeds	Concerns the identification of pests, diseases and weeds that threaten citrus production. Also considers various methods of effective control, and the planning required for this purpose.
Crop Protection	Looks at the practical application of crop protection agents through various methods, with specific reference to tools and equipment used, and health and safety requirements.
Food Safety	Concerns the requirements in terms of health and safety, and environmental control for ensuring food safety and hygiene.
Harvesting	Looks at the process of determining fruit maturity through maturity indexing, the harvesting of fruit, and the tools and equipment used for this purpose.
Conservation	**Considers the impact of farming practices on the environment, with reference to the measures required to minimise this impact and protect the environment.**

Skills Area	***Description***
Marketing	Concerns the factors influencing citrus marketing, and the development of an effective marketing plan.
Production Management	Concerns the actions and processes involved in effective production management, with specific reference to the coordination of the various production tasks and processes and the creation of a strategic plan for the enterprise.
Industry Overview	An overview of the citrus industry and the various institutions involved.
Packhouse Practices	Concerns the specific principles and practices that are employed in packhouse environments, and specifically: • Receiving • Sorting • Grading • Fruit Sizing • Cold Chain Management • Packing • Palletising • Storage • Dispatch • Fruit Markets • Fruit Quality • Fruit Treatment • Health and Safety • Hygiene • Product Characteristics

Chapter 1

After completing this chapter, the learner will be able to:

Demonstrate an understanding of natural resources and recognise how sound management contributes towards sustainable farming systems

Timeframe

You have to complete this section as follows:

Total time	***Theory***	***Practical***
9h	4h 30min	4h 30min activities

1. Introduction

Facilitator Tip

Have a general discussion on natural resources, and ensure that learners are familiar with the concept. Encourage learners to identify different examples of natural resources.

The environment consists of various elements, referred to as natural resources, being:

- Ground (rocks and soil)
- Water (fresh and sea or marine water)
- Atmosphere (air constituents and weather patterns, manifesting as climate)
- Fauna (animals and other living beings)
- Flora (plants)

Each element works within a structured system and in coordination with the other elements to ensure its own survival. **Harmony** and **balance** in the natural environment is essential to life.

Through understanding how delicate our world is and realising the importance of harmony and balance, we can learn to maintain all resources on earth and live in a healthy and better world. Sustainable farming operations are achieved through greater understanding, and through the implementation of good farming practices.

2. Local Natural Resources

Facilitator Tip

Accompany the learners on a scouting expedition and identify the natural resources in the surroundings. Call attention to how these resources are utilised to support human activities and encourage thinking on how these activities would be affected if resources were not maintained.

Definition

Resources A resource is a natural or man-made element. It can be utilised to meet human needs. **Renewable** resources come from sources that are constantly renewed – the wind keeps blowing, the sun keeps shining and the earth keeps heating the ground. **Non-renewable** resources are exhaustible, meaning it cannot be replenished easily, such as fossil fuels, usable water, and soil lost through erosion.
Natural Resources Natural resources are materials that occur in nature and are essential or useful to humans, such as water, air, land, forests, fish and wildlife, topsoil, and minerals. Natural resources that are alive, such as plants, are called **biotic** resources. Natural resources that are not alive are **abiotic**, for example water.

The following are a few examples of local resources:

- ***Soil and soil elements*** provide a perfect growing medium for plants and provide many resources for man.

- ***Water*** is life. Without water, the earth would not exist. Water constantly recycles between sea, air, soil and land surface in what is referred to as the water cycle.

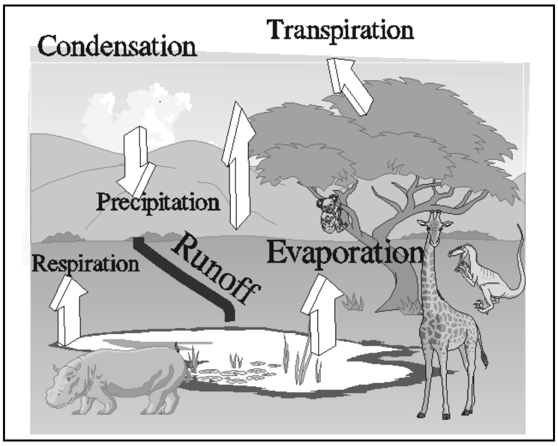


Figure 1.1: The Water Cycle

- ***Flora*** refers to both indigenous and alien plants. Indigenous plants are adapted to our climate and grow in different areas in South Africa. Alien plants are native to other countries. Flora provides wood and fuel, and ensures that oxygen is replenished in the atmosphere.

- ***Fossil fuel*** is formed in the ground from the remains of dead plants and animals. The heat of the earth helps with the development of fossils. Although some scientists still stick to the theory that it takes millions of years for fossil fuels to form, under the right conditions, fossil fuels can form a lot more rapidly. Recent theories put the age of pressurised oil wells at between 4,000 and 5,000 years. It is however true that it takes a lot longer for fossil fuels to form than the rate at which we are using them up. Oil, natural gas and coal are examples of fossil fuels.
    - ***Coal*** is a solid fossil fuel found in the earth. Coal is burned to make electricity. Coal is the remaining carbon from dead, fossilised plants.
    - ***Natural gas*** is a fossil fuel found deep in the earth. Natural gas is often found with oil. It is a by-product of decaying organic matter in the underground layers. Primordial gasses also exist and rise up from the mantle of the earth.
    - ***Oil*** is a liquid fossil fuel found deep in the earth. Petrol and some plastics are made from oil. Oil is formed when any organic matter is trapped in sedimentary rock, die and fossilise.
- ***Solar energy*** is energy from the sun and can be captured and turned into electricity with special solar panels.

3. Waste and Pollution

Facilitator Tip

To understand this, learners have to understand what ecosystems are. It is recommended that groups are assigned a self-study task to identify and understand an ecosystem, and to identify and discuss the impact of waste and pollution on this specific ecosystem. Spend time scouting an agricultural environment for sources of waste and pollution and identify their impact on the environment and health. Encourage learners to come up with remedies to these problems.

Undisturbed ecosystems are ecological communities together with its environment, which functions as a cohesive unit. In such environments, substances decompose and are eventually broken down, as most natural elements are biodegradable, which means that becomes part of the earth again. Humans however create waste and pollution that may not be biodegradable. Waste is produced when humans utilise resources to create energy.

Definition

Waste

Waste refers to the "leftovers" or unwanted products from industries and other human activities.

Pollution

Pollution is the unwelcome concentration of unnatural, harmful or poisonous substances that are beyond the environment's capacity to handle. These substances are detrimental to people and other living things.

Farm activities result in a certain amount of waste. It is the responsibility of farm management to control and limit the amount of waste, but workers must be able to identify waste and control it before it pollutes the environment. In the table below, various sources of waste and pollution is described.

Target Resource	*Source of Pollution*	*Health and Environmental Effects*	*Remedies*
Air	Burning coal for energy	• Acid rain • Respiratory problems • Global warming Acid rain and global warming are earth threatening environmental pollutants (see definitions below table).	Using more efficient energy sources
Air	Fumes from vehicles	• Smog • Respiratory problems • Restricts breathing • Global warming	Limiting vehicle use where possible, using more environmentally friendly fuels
Air	Land clearing	• Smoke	Controlling fires when burning firebreaks
Air	Noise from traffic	• Affects hearing	Limiting vehicle use where possible
Water	Organic and inorganic nutrient enrichment (fertiliser run-off)	• Toxic algal blooms poisons the water, causing liver disorders, cancer and other diseases in humans • Kills aquatic life by inhibiting light penetration and by de-oxygenating the water	Do not over fertilise. Check run-off and use natural filters like reed marshes or sugar beet to capture surplus nutrient salts.
Water	Sewage from inadequate sanitation	• Pathogens that cause many diseases and illnesses in humans	Using toilets with a suitable sewage system
Water	Build-up of silt in dams	• Kills aquatic life • Destroys the food chain	Practicing soil maintenance and preventing erosion in daily farm activities
Water	Agrochemicals	• Toxicity • Interferes with breeding of animals • Destroys the food chain • Cause illness if water is consumed	Handling and storing agrochemicals and disposing of used containers in an eco-friendly manner. Old or used containers must not be reused, but punctured and stored safely until disposal
Land	Hazardous solid waste (radioactive, chemicals, poisons)	• Threatens the health and lives of humans	Awareness of threats posed by waste products, and proper control and disposal.
Land	Non-hazardous solid waste (domestic, urban)	• Unsightly • Disposal uses up land space • Can contaminate surface water	Limiting domestic waste, purchasing products with environmentally friendly packaging

Table 1.1: Sources of Waste and Pollution

Facilitator Tip

All learners may not be familiar with the concepts of acid rain or global warming. If possible, conduct mini-experiments in which these concepts are illustrated. For example, blow air through a straw into a bowl of water to show how carbon dioxide, the expelled gas from the lungs, dissolves in the water and acidifies it. Place soil in a cut plastic cold drink bottle hothouse and show how the heat is trapped in the system to illustrate global warming.

Definition

Acid Rain

When water in the air combines with gasses, most importantly sulphur and nitrogen, rainwater becomes more acid and is referred to as acid rain.

Global Warming

Global warming is the increase in the average temperature of the earth's lower atmosphere as a result of an increase in greenhouse gasses since the industrial revolution. Greenhouse gasses are water vapour, carbon dioxide, methane, nitrous oxide and ozone. The sustained increase in temperature causes climatic changes.

Acid rain occurs naturally where active volcanoes erupt, where there is lightning, or if there is bacterial action in the soil. Acid rain has however reached levels where the environment is no longer able to cope with it due to increased human activity that produces sulphur dioxide and nitrous oxides. The burning of fossil fuels, for example in power stations, factories and petroleum-based vehicles, contributes to this problem.

The all too frequent oil wars also cause huge amounts of sulphur and nitrogen to enter the atmosphere in a relative short time period and pose a serious environmental and climatological threat to the earth's survival systems. If materials and equipment is used carefully and responsibly, its lifespan can be extended and the amount of waste can be reduced. Farmers must follow regular calibration and maintenance plans, which will reduce wear on tyres and other equipment.

4. Reusing Waste

Facilitator Tip

Pose these questions to the learners:

- Why should we reuse and recycle waste?
- Which household wastes can we reuse or recycle and how?
- Are there also wastes on farms that can be reused or recycled?

Definition

Reuse

Reusing waste means employing certain waste items for a different purpose, for instance using empty non-chemical plastic containers for storage.

Recycling

Recycling means reprocessing waste material and using the material to make new items, such as melting down old plastic containers and using the plastic to make new containers.

Some waste, including materials and by-products, can be reused. Ideally it should however be reduced and recycled where possible. Recycling or reusing waste products should be part of a farm's daily practice. The following are examples of waste and their uses as a resource:

Waste	*Resource*
Paper	• Use as fuel for burning
Wood	• Use as fuel for burning
Plastic Containers (Non-chemical)	• Use as storage containers in workshop and field • Small containers can be used to manually apply granular fertiliser
Metal	• Recycle
Oil	• Recycle
Tyres	• Use to support soil in erosion areas, such as gullies
Organic Waste	• Can be incorporated, composted or if suitable, fed to animals

Table 1.2: Waste as Resources

5. Energy

Facilitator Tip

These may be difficult concepts for learners at this level. Demonstrate what is meant by working energy and latent energy. Pick up a pen and explain to learners that the working energy that you used to pick up the pen, has now been transferred to the pen as latent energy, which it will use to fall when you drop it.

Definition

Energy

Energy is the ability to do work and it comes in various forms of heat and light. There are two main types of energy, being working energy and stored, or latent, energy. Stored energy becomes working energy when it is used.

We use energy every day. It is used to grow food, to warm and cool homes, make electricity, run cars, make products like clothes and toys and any other items. It is a very important part of our lives. Most countries use stored energy for fuel. By burning fuel, the stored energy is set free in the form of heat. Fossil fuels, such as oil, gas and coal, are mostly burnt.

Fossil fuels form over time from the remains of dead animals and plants. Dead plants and animals are buried under dirt and rock, where the heat from the earth and the pressure from the soil and rocks change them into fossils and then into oil, natural gas and coal. Because it can take thousands of years to make or renew fossil fuels, they are referred to as a non-renewable resource.

More than 75% of South Africa's energy comes from coal. One half of this is used to generate electricity, a quarter is used to produce liquid fuels, and the other quarter is used as fuel to heat homes. South Africa is the country in the world that is the most dependent on coal, and therefore we need to look at generating energy from alternative sources.

6. Alternative Energy Sources

Facilitator Tip

Some learners may have been exposed to alternative energy sources. Where possible, show images or play video footage of such energy sources. Ensure that the reasons for the use of alternative energy sources are understood and that the benefits can be recalled.

The alternative energy sources that are used mostly are:

- Solar energy
- Wind energy
- Water energy
- Nuclear energy
- Bio diesel

6.1. Solar Energy

Facilitator Tip

Learners will identify with the sun's heat, but might not have thought of it as an energy source. Bring an example of a solar-powered calculator to class and point out its solar cells. Discuss how it harnesses solar energy, and discuss other solar technologies on this basis.

Encourage learners to think of other ways of using the heat and light from the son as an energy source, such as through heating water by pumping it through a length of black poli-pipe, which is a method used by many people to heat water in swimming pools.

The sun is a great source of energy, which is referred to as solar energy, which can be turned into electricity or heat. Solar energy are used in many ways, for example by simply keeping the curtains open during the day, sunlight can light and warm a room.

Example

Solar Energy

Cars with dark seats are good examples of how the absorbers in a solar collector work. Have you ever sat on a dark seat after the sun's solar energy passed through the windows of a car? The seats absorb heat and feel hot. If the seats were white, the light would be reflected away from the seats and they would absorb less heat.

Technology has been developed to harness the energy of the sun, so that it can be stored and used by humans for heating or electricity generation. Solar energy systems, or solar collectors, produce energy without releasing pollution particles or chemicals into the air. Most solar collectors are boxes that have the following components:

- Clear covers to let the solar energy in.
- Dark surfaces, called absorber plates, on the inside to soak up the heat.
- Insulation material to prevent heat from escaping.
- Vents or pipes to carry the heated air or liquid from inside the collector to where it can be used.

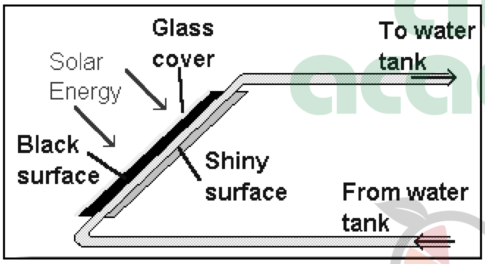


Figure 1.2: Simple Solar Water-Heating Device

Solar energy systems fall into three main categories, being:

- ***Photovoltaic Cells***, also known as PVs, absorb sunlight and a chemical reaction occurs, turning sunlight into electricity.
- ***Passive solar systems*** use sun for lighting and heat by absorbing sunlight and slowly releasing it even after the sun sets.
- ***Solar Thermal Systems*** heat water or air by using a mechanical device to move it across surfaces that have absorbed sunlight.

6.2. Wind Energy

Facilitator Tip

Show how wind energy can be used by making a mini-windmill with paper and a straw. Show how the wind blows the mill, which might power a motor to do work such as pumping water from a subsoil reservoir.

When the power of wind is used to generate electricity, it is referred to as wind energy. The wind turns large fans that power a generator to make electricity. The power of the wind to generate electricity is proportional to the wind speed. Much more electricity can therefore be generated in places with high average winds speeds, and "wind farms" are often established in such places. The windier the location, the more kilowatt-hours can be generated.

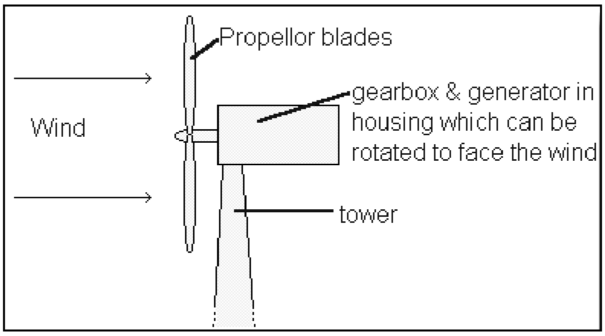


Figure 1.3: Fan Used to Generate Electricity through Wind Energy

6.3. Water Energy

Facilitator Tip

Obtain photographs of a hydro-electric scheme, such as the Cahora Bassa scheme, and take it to class to show to the learners. Encourage learners to think of examples of where water is used as an energy source.

Water is another renewable source of energy. A watermill or a hydro-electric scheme uses the force of water to generate electricity. Water moves across impellers, rotating them and generating electricity.

6.4. Nuclear Energy

Nuclear energy is generated by using special radioactive materials. Harmful substances are not released when nuclear energy is generated. However, once the radioactive material has been used to generate energy, the waste remains radioactive and hazardous to all living organisms. The waste material must be stored safely for thousands of years to avoid contamination.

6.5. Bio Diesel

Bio diesel is a liquid fuel than can replace regular diesel. It is made from used vegetable oil from deep fryers or freshly grown grains, such as maize. The particles released from burning regular diesel can cause cancer, but by using bio diesel this hazard can be reduced. Bio diesel is a renewable energy source.

7. The Role of Carbon

Carbon is an important element. It is not only found in minerals, such as diamonds, but also in the tissue of living organisms. Carbon atoms are the main component of all organic compounds, including sugars, starches, fats, proteins and coal.

Carbon compounds give us energy (food), keeps us warm (wood and coal), and power vehicles and industry (oil petrol and natural gases).

7.1. The Role of Carbon Dioxide

Plants absorb carbon dioxide from the atmosphere and use it with sunlight, water and soil minerals to produce energy-rich organic compounds, such as carbohydrates. This process is known as photosynthesis.

Too much carbon dioxide in the atmosphere however has a negative effect on the environment. Carbon dioxide traps heat in the earth's atmosphere, making life on earth possible, but if there is too much carbon dioxide, an imbalance is created resulting in a greenhouse effect, which leads to global warming.

The over-production of carbon dioxide that causes this imbalance is the result of the burning of fuel, such as coal. At the same time, vast tracts of vegetation are being destroyed due to deforestation, affecting the rate of photosynthesis. This means that while we are producing more and more carbon dioxide, there are less and less plants that are able to absorb and use it.

The earth is becoming warmer and the global climate is changing. In South Africa, some areas are becoming hotter and drier, while other areas experience more frequent and extreme floods.

7.2. The Role of Carbon Sinkholes

Facilitator Tip

Spend sufficient time in explaining this concept and ensure that learners understand the origins of carbon sinkholes and.

Definition

Carbon Sinkholes

Carbon sinkholes are where carbon is stored after being returned to plants and soil through photosynthesis.

Farmers are key players in creating carbon sinkholes. Grasslands are a temporary carbon sinkhole, because the carbon is lost when grass is burnt and carbon dioxide is released. Forest and fruit trees grow slowly and store organic carbon for many years.

Soil is the ultimate carbon sinkhole. About 60% of organic carbon occurs in soil. Soil enriched with organic matter is a stable carbon sinkhole, because carbon is stored for long periods of time. Land is managed to store more carbon by:

- Minimising tilling to conserve organic matter and to stabilise the soil structure and reduce erosion.
- Adding organic matter, lime and sulphur to the soil to increase soil fertility, structure and water holding capacity.
- Restoring erosion areas on farms, thereby enhancing ecological processes and resilience of the ecosystems.
- Using renewable sources of energy. It is preferable to burn firewood grown in woodlots or plantations rather than burning coal. Avoid cutting down indigenous plants.

Facilitator Tip

Summary

This is an opportunity to check the progress that learners have made.

Allow time for the learners to read through the summary and to gauge their own progress. Make sure that each and every learner gets and opportunity to ask questions.

Summary

Chapter 1

- The environment is made up of various elements, or natural resources, namely ground, water, air, fauna and flora.
- Renewable natural resources are resources that nature reproduces constantly, while non-renewable natural resources are resources that cannot be reproduced, or are reproduced over many years.
- Biotic natural resources are alive, such as plants and animals, while abiotic natural resources are not alive, such as water and air.
- Waste is what is left over once resources have been used to create energy.
- Pollution is the over-production of waste that the environment cannot deal with naturally.
- Acid rain and global warming are deadly consequences of pollution.
- Reusing means using a waste product for another purpose, while recycling means reprocessing waste products to produce other products.
- Energy is the ability to work and is produced from using resources. There are two forms of energy, being working and stored energy.
- Traditional energy sources use stored energy from non-renewable resources, such as the burning of fossil fuels.
- Alternative energy sources aims to use renewable resources and include solar energy, wind energy, water energy, nuclear energy and bio diesel.
- Carbon is the building block of life as most living organisms are made up mostly of carbon atoms.
- Carbon dioxide is produced through amongst others the burning of fuel, and used by plants during photosynthesis.
- Higher production of carbon dioxide and reduction in plants causes an imbalance that causes a greenhouse effect and leads to global warming.
- Carbon sinkholes are where carbon is stored, mostly in organic form in plants and in soil.

Practical

Complete activities 1, 2 and 3 in the **Learner Workbook**.

Facilitator Tip

Activity 1 – Group Discussion

Explain the concept of brainstorming and allow time for groups to break away and complete the activity. Allow time for groups to report back and comment on each other's conclusions.

Timeframe: 1h 30min

Activity 2 – Group Discussion

Allow time for groups to break away and brainstorm their ideas. Then present groups with examples of reusable or recyclable wastes and ask groups how they would recycle it.

Timeframe: 1h

Activity 3 – Group Debate

Divide the class into 2 groups and assign each group with the task as follows:

Group A – Traditional energy sources work very well and there is no reason to change how, where, when and how much energy we use on our farms.

Group B – Alternative energy sources are the way of the future, and if we do not modify our behaviour and start changing the way in which we are currently using our energy sources on farms, then we will definitely run out sooner, rather than later.

Explain the method of holding a debate. Allow sufficient time for preparation.

Timeframe: 2h

Chapter 2

After completing this chapter, the learner will be able to: **Recognise harmful and useful fauna and flora and their purpose and/or effect on the farm**

Timeframe

You have to complete this section as follows:

Total time	*Theory*	*Practical*
5h	5h	

1. Introduction

Facilitator Tip

Scout with the learners and find examples of fauna and flora in their immediate area. Revise the role of fauna and flora in ecosystems.

Definition

Fauna Fauna is the term used for all living organisms on earth, including animals.
Flora Flora refers to all vegetation on earth, including trees, flowers and grass.

Fauna and flora exist together in ecosystems and are dependent on each other for their survival. When the natural environment is destroyed by humans through deforestation or irresponsible farming practices, neither plants nor animals can survive.

Nature conservation has become an issue of great concern to many governments throughout the world. It is essential that we understand the importance of fauna and flora and strive to maintain and improve conservation measures.

South Africa has an abundance of flora and fauna. Flora and fauna that originate in South Africa, meaning that those species that were first grown or found naturally in this country, are known as **indigenous** species. Many indigenous plants have become well known on the international markets.

The Barberton Daisy, or Gerbera, is a top-seller in the international cut flower industry. Proteas, a species of "fynbos" or *schlerophyta*, are just as well known.

Different indigenous plants grow in different areas in South Africa, and have adapted to the South African climate.

2. Ecosystems

Facilitator Tip

Refer back to the research on ecosystems that the learners did in the first session, and encourage them to add their own findings.

There are many different types of ecosystems that are important to the existence of every creature on earth. The most vulnerable ecosystems are:

- River catchments
- Wetlands
- Grasslands
- Estuaries

2.1. River Catchments

River catchments are essentially large drainage basins. It includes all the land from the top of mountains where water flows into a river to the sea. Plants growing in the catchment areas are a natural anti-erosion measure. Plants slow down the flow of water and allow it to seep into the ground. Plants also stabilise the soil.

2.2. Wetlands

Wetlands are important ecosystems, because they act like a giant shallow bowl or sponge that absorbs water and slowly releases it over time. This natural action reduces erosion and regulates a steady flow-rate of water. Wetlands are important for the replenishment of groundwater reservoirs.

2.3. Grasslands

Grasslands can be flat, hilly or mountainous areas with few trees except along rivers. The grassland vegetation has adapted to its climate. Grasslands are home to many endangered animals and plants, and have much greater plant diversity than forests. Grasslands are thought to be one of the most ancient vegetation types in the world.

Only 2% of South Africa's grasslands are conservation areas. Grasslands once covered 60% of Africa but, due to changing climatic conditions, mining, agriculture and urbanisation, this figure has reduced dramatically.

The main threats to grasslands are:

- Agriculture and timber plantations
- Urban and industrial expansion
- Mining
- Over-grazing of sheep and cattle
- Alien plants
- Pollution

2.4. Estuaries

An estuary is the meeting place between a freshwater river and the saline sea water. It is breeding ground for many marine species, which is why many towns were established near estuaries, for example Durban, Knysna, and Richards Bay.

Poor farming practices can cause chemical and fertiliser pollution and can lead to soil erosion. These pollutants and eroded soil end up in rivers, endangering estuaries. Damming of rivers reduces the flow of fresh water to the estuaries, which leads to an imbalance in the ratio between fresh water and seawater, which can endanger the lives of fauna and flora.

3. Beneficial and Non-Beneficial Fauna and Flora

Facilitator Tip

Ensure that learners understand the term *beneficial* and encourage them to find or name examples of beneficial organisms in their agricultural environment. Be alert to learners who might not know the differences between fungi, viruses and bacteria or know that these organisms play a role in agriculture.

All natural fauna and flora is essential to healthy ecosystems. The distinction between beneficial and non-beneficial fauna and flora are made on the grounds of their impact on humans, and human interests.

Fruit trees are for instance seen as beneficial flora, because it provides food, while lantana is seen as non-beneficial fauna, because it is considered a weed that threatens the existence of beneficial flora. The distinction is often subjective and depends on the viewpoint of the human.

In this section, we will look at various examples of fauna and flora that are considered beneficial and non-beneficial in a citrus production environment.

3.1. Beneficial and Non-Beneficial Fauna

3.1.1. Micro Organisms

Micro organisms are so small that they are not visible to the naked eye and can only be seen under a microscope. Beneficial micro organisms are for instance those find in soil, which help to break down plant and animal waste into organic material.

There are three main types of non-beneficial micro organisms, being:

- Fungi
- Viruses
- Bacteria

3.1.1.1. Fungi

Fungi are small threads that spread quickly through plants. Fungi do not produce their own food, but consume the plant for food and water. Fungi cause diseases, referred to as fungal diseases, in plants.

Fungi attack the roots, leaves and trunks of citrus plants, resulting in a smaller crop. Phytophthora is an example of such a fungus, causing root rot, collar rot of the lower trunk and brown rot on low hanging fruit. *Alternaria spp* is another example. It causes internal rot of fruit, mainly navel oranges with open navel ends. Another species of *Alternaria* causes Alternaria Brown Spot which can cause fruit blemishes and fruit and leaf drop in certain varieties, such as minneola, Empress mandarin and nova.

3.1.1.2. Viruses

Viruses are smaller than fungi and can spread very quickly. There are many types of viral plant diseases. When a plant is attacked by a virus, crop growth can slow down, fruit can be of poor quality and / or crop losses can occur, depending on the type of virus.

The Tristeza virus is endemic in Southern Africa and is transmitted by the black citrus aphid. Grapefruit trees are particularly susceptible and tree life can be reduced by 10 to 15 years. Citrus exocortis is a bark-scaling and tree stunting virus that affects trees budded onto trifoliate orange and some of its hybrids.

3.1.1.3. Bacteria

Bacteria enter the plant through wounds caused for example by hail or implements. The bacteria grow inside the plant, consuming it for food and water.

Greening disease is caused by an organism that is not a true bacterium, but bacteria like. This deadly disease is carried by citrus psylla, which acts as the **vector** for the disease.

Canker is a highly infectious disease that is also caused by a bacterium. It has been eradicated in Southern Africa, but is still a serious problem in the citrus producing regions of Florida in the USA, causing yellow spots on fruit and leaves and, in severe cases, defoliation.

3.1.2. Insects

Facilitator Tip

Most learners will know of beneficial and pest insects. Send learners out on a 20 minute scouting exercise in which they have to identify pest insects as well as beneficial insects. Allow tem to report back on what they identified and discuss why they classified the insects as beneficial or pests.

Honeybees are a good example of beneficial insects. They pollinate plants as they fly from tree to tree, which is the first step in producing fruit. They also produce honey, which is a food source to humans.

Insects are beneficial for different reasons. They could serve as pollinators, as is the case with bees, or they might be predators of other harmful insects. They may be very territorial, keeping other insects out, or excrete toxins or pheromones that keep other pests away.

Various insects are considered pests in terms of citrus production. Examples are red scale, false codling moth, fruit fly and mealybug. All of these insects are considered pests because they have a detrimental effect on fruit production. In some cases, such as in the case of red scale, the insect can cause harm to the tree itself, which may have a detrimental effect on tree growth. In other cases, such as in the case of false codling moth and fruit fly, the insects cause damage to the fruit, which means that the fruit cannot be sold. In other cases still, the pest may secrete substances that attract other pests, such as ants.

The various pests and diseases that impact on citrus production, and the various control measures used for them is discussed in great detail in another learning module.

3.2. Beneficial and Non-Beneficial Flora

Facilitator Tip

Send learners on a 15 minute scouting exercise to identify examples of beneficial and non-beneficial flora. Allow them to discuss the reasons for classifying it as beneficial or non-beneficial.

Flora is considered beneficial on the ground of its ability to produce food, the shade that it provides to humans, or its aesthetic value. Citrus trees are a very good example of beneficial flora in the context of citrus production.

Non-beneficial flora is commonly referred to as weeds. Weeds are any plant that grows where the farmer, gardener or other human does not want it to grow. Grass growing in a vegetable garden is for instance considered a weed, as it is competing with the vegetables for food and water. The same grass growing in a field is however considered as beneficial flora, as it is a food source for livestock.

Weeds are controlled manually or chemically through the use of herbicides.

Apart from flora that are beneficial to humans for obvious reasons, such as fruit trees, there are also a number of plants that are sometimes consider weeds, but that may have medicinal benefits, or that may be useful in repelling harmful insects. Examples of such plants are in the table below.

Insect	***Beneficial Flora***	***Application***
Ants	Garlic	Crush four garlic bulbs into 4l of water, add 1 cup washing powder and mix. Pour into holes.
	Khakibos	Dry and crush to powder. Sprinkle around holes.
	Mint	Chop and sprinkle around holes.
Aphids	Mint	Grow nearby
	Nasturtium	Grow between plants
	Nettle	Grow nearby
Fruit fly	Cayenne pepper/ Chillies	Sprinkle cayenne pepper or ground chillies on leaves and around trees

Table 2.1: Beneficial Flora

Alien plants are discussed in detail in the next chapter.

4. Attracting Beneficial Fauna and Flora

Facilitator Tip

Lead a class discussion and build the discussion around the questions below. Encourage learners to actively participate, give input, share personal experience and ask questions:

- Why would we want to attract beneficial fauna and flora?
- How can we encourage indigenous fauna and flora to become established?
- How can we attract beneficial organisms?

Indigenous plants do not compete with another, but have a symbiotic relationship, meaning that they are of benefit to one another.

Establishing and maintaining a healthy environment encourage beneficial fauna and flora to establish itself. Excessive use of pesticide, fungicide and herbicides also has a negative impact on the populations of beneficial plants and animals. It is vital that scouting becomes part of the daily management schedule to ensure agrochemicals are only applied when absolutely necessary.

Beneficial animals and plants are attracted by:

- Removing all category 1-invader plants on your farm;
- Encouraging wildlife activity; and
- Limiting the use of chemical pest and weed control products

Pests and diseases can be controlled by natural control measures, such as using insects that feed on or parasitise pest insects. There are also plants that can be used to control pests.

Using compost naturally enhances soil fertility and can supplement soil fertilisation chemicals with nutrients that are readily available to plants. Mulching has many advantages that allow a farmer to use less chemical control measures, including:

- Prohibiting excessive weed growth;
- Preventing soil from drying out too quickly;
- Mulching material rotting and being incorporated into the soil by worms and other soil inhabitants to improve soil fertility;
- Preventing surface runoff and soil erosion; and
- Preventing extremes in soil surface temperatures.

Facilitator Tip

Divide the class into five groups. Give them the following tasks to research and report back on:

- You have to eradicate a very heavy infestation of Port Jackson near the dam on the farm. Why do you have to remove the Port Jacksons? How will you remove the Port Jacksons?

- You have to prevent the soil from drying out in one of the orchards because it is sandy and the soil gets very hot. Why do you have to retain moisture in the soil? How will you retain moisture in the soil?
- You have to attract predatory organisms to the orchards. Why would one want to attract predatory organisms to orchards? How will you attract these organisms?
- You have to prevent erosion on the dam wall. How would you know that the area is prone to erosion? How will you prevent the erosion from occurring?
- You have to control weeds in the orchards. Why should you control weeds? How will you control weeds?

Summary

This is an opportunity to check the progress that learners have made.

Allow time for the learners to read through the summary and to gauge their own progress. Make sure that each and every learner gets and opportunity to ask questions.

Chapter 2

- Fauna means all living organism on earth, while flora means all plants, or vegetation.
- Indigenous flora refers to plants that were originally found in an area or in a country, and that have adapted to the local climatic conditions.
- Fauna and flora are interdependent for life, and live together in ecosystems, such as river catchment area, wetlands, grasslands and estuaries.
- The distinction between beneficial and non-beneficial fauna and flora is in many cases subjective, and depends on the human being making the judgement. Non-beneficial fauna and flora is considered as such because it impacts negatively on the needs of humans.
- Non-beneficial fauna in citrus production includes micro-organisms, such as fungi, viruses and bacteria, and insects that attack citrus trees.
- Non-beneficial flora is commonly referred to as weeds, which can be controlled manually or chemically.
- Beneficial fauna and flora are attracted to a healthy environment, which can be encouraged by limiting the use of chemical control measures, removing alien plant species, and encouraging wildlife activities.
- There are natural alternatives to chemical weed and pest control measures, and natural soil fertilisation can be used in addition to chemical fertilisation.

Chapter 3

After completing this chapter, the learner will be able to:

Eradicate alien plant species and noxious weeds

Timeframe

You have to complete this section as follows:

Total time	***Theory***	***Practical***
5h	3h 30min	1h 30min activities

1. Introduction

Facilitator Tip

Make sure that the learners understand the term *biodiversity*. Discuss the biodiversity of South Africa and discuss the reasons for protecting it and the benefits it holds in terms of for instance tourism.

South Africa has the third richest biodiversity in the world, which is under considerable pressure and threat. The remarkable richness of South Africa's biodiversity is a result of the mixture of tropical, subtropical and temperate climates and habitats, which gives rise to extraordinary plant variety.

Human activity has changed ecosystems in South Africa. Ecosystems have been degraded and ecological processes impaired. One of the reasons for this is the increasing growth of urbanisation and industrialisation. The South African Red Data Book reports that the following percentages of species can be considered threatened:

- Plants: 15%
- Amphibians: 18%
- Reptiles: 24%
- Birds: 14%
- Mammals: 37%
- Butterflies: 22%

Alien plant species is another factor that threatens biodiversity and indigenous plant species.

2. Identification of Alien Plant Species

Facilitator Tip

Explain alien plants as invasive species and identify as many examples of alien plants as possible. Show examples or identification charts of invasive plants in the immediate environment.

Definition

Alien Plants

Alien or invasive plants refer to plants that do not originate in South Africa. They cause problems by using 10% of South Africa's annual rainfall, killing indigenous plants, causing fires and soil erosion, and endangering many animals.

Alien plants came to South Africa as garden plants, in horse feed, and with forestry plantations. Alien plant species grow well in South Africa because they have no natural enemies such as insects, animals and disease that would control them in their original countries.

Some alien plants spread less aggressively than others. The Department of Water Affairs has identified and categorised 198 invader or alien plants in South Africa. These alien plants have detrimental affects on farming areas, indigenous bush, water supply, cause fires, and increase soil erosion. For more information refer to www.dwaf.gov.za for a detailed list.

Alien plants are classified as follows:

- **Category 1:** Invader plants that must be removed and destroyed immediately.
- **Category 2:** Invader plants that may be grown under controlled conditions only.
- **Category 3:** Invader plants that may no longer be planted, but that does not have to be removed.

Alien plant species grow in different regions in South Africa. For the purpose of the classification, South Africa has been divided into three sections, namely:

- **Subtropical Region:** KwaZulu-Natal, Mpumalanga, Limpopo, North-West Province, Gauteng
- **Fynbos Region:** Western and parts of Eastern Cape
- **Arid Region:** Northern Cape, parts of Eastern Cape, Free-State

2.1. Subtropical Region

In the table below, the alien plants that are found most commonly in the subtropical region is listed together with its control measures.

Category	*Invader Plant Name*	*Control Measures*
1	Bug Weed (*Solanum mauritianum*)	• Saw • Hand-pull • Bio control • Herbicide
1	Sweet Prickly Pear (*Opuntia ficus indica*)	• Bio control • Herbicide

Category	*Invader Plant Name*	*Control Measures*
1	Triffid Weed (*Chromolaena odorata*)	• Saw • Hand-pull • Herbicide
1	Water hyacinth (*Eichornia crassipes*)	• Hand-pull • Bio control • Herbicide
1	Lantana (*Lantana camera*)	• Saw • Hand-pull • Bio control • Herbicide
1	Mauritius Thorn (*Caesalpinia decapetala*)	• Bio control • Herbicide
2	Black wattle (*Acacia mearnsii*)	• Saw • Hand-pull • Bio control • Herbicide
2	Grey Poplar (*Populas x canescens*)	• Saw • Hand-pull • Herbicide
3	Syringa (*Melia azedarach*)	• Saw • Hand-pull • Herbicide

Table 3.1: Alien Plants Commonly Found in Subtropical Regions

2.2. Fynbos Region

Category	*Invader Plant Name*	*Control Measures*
1	Lantana (*Lantana camera*)	• Saw • Hand-pull • Bio control • Herbicide
1	Silky Hakea (*Hakea sericea*)	• Saw • Bio control
1	Australian Myrtle (*Leptospermum laevigatum*)	• Saw • Bio control
2	Grey Poplar (*Populas x canescens*)	• Saw • Hand-pull • Herbicide
2	Black Wattle (*Acacia mearnsii*)	• Saw • Hand-pull • Bio control • Herbicide
2	Australian Blackwood (*Acacia melanoxylon*)	• Saw • Hand-pull • Bio control • Herbicide

Category	*Invader Plant Name*	*Control Measures*
2	Rooikrans (*Acacia Cyclops*)	• Saw • Hand-pull • Bio control • Herbicide
2	Cluster Pine (*Pinus pinaster*)	• Saw

Table 3.2: Alien Plants Commonly Found in Fynbos Regions

2.3. Arid Region

Category	*Invader Plant Name*	*Control Measures*
1	Sweet Prickly Pear (*Opuntia ficus indica*)	• Bio control • Herbicide
1	Oleander (*Nerium oleander)*	• Saw
1	*Stipa Trichotoma*	• Hand-pull • Herbicide
1	Queen of the Night (*Cereus jamacaru*)	• Hand-pull • Bio control • Herbicide
1	Rosea Cactus (*Opuntia rosea*)	• Bio control • Herbicide
2	Sisal (*Agave sisalana*)	• Herbicide
2	Wild Tobacco (*Nicotiana glauca*)	• Saw
2	Honey Mesquite (*Prosopis glandulosa*)	• Saw • Herbicide

Table 3.3: Alien Plants Commonly Found in Arid Regions

3. Clearing Alien Plant Species

In the tables in the previous section, the control measures for the various alien species are stated. The following method is used for removing alien plants:

- Identify area with invader plants and weeds.
- Segment the area into manageable units.
- Remove invader plants from the first segmented area by using the measure stated in the tables above.
- Make sure that personnel handling chemicals are trained to apply any chemical and understand the precautionary measures.
- Be careful not to remove all vegetation. Remove the invaders, but retain the indigenous plants and prevent weeds from taking over.
- Once the first segment is cleared, move onto the next area.
- Remove secondary growth of the invader in the cleared area by the same methods as listed above.
- Maintain area to ensure no re-growth occurs.
- Continue with the process until no re-growth or new seedlings emerge.

- Removed plant material can be used as a compost or mulch.

Facilitator Tip

Summary

This is an opportunity to check the progress that learners have made.

Allow time for the learners to read through the summary and to gauge their own progress. Make sure that each and every learner gets and opportunity to ask questions.

Summary

Chapter 3

- Alien, or invasive, plants are plant species that are not indigenous, and were brought to South Africa as garden plants, in horse feed or when plantations were established.
- Alien plants proliferate in South Africa because they do not have any natural enemies in their environment.
- Alien plants are categorised as follows: plants that must be removed and destroyed immediately, plants that may be grown under controlled conditions only, and plants that may no longer be planted, but that does not have to be removed.
- Alien plants are controlled by means of sawing, hand-pulling, bio control or herbicides.

Practical

Complete activity 4 in the **Learner Workbook**.

Facilitator Tip

Activity 4 – Practical Projects

Allow time for learners to complete this activity individually and as a practical task on the farms. Encourage learners to seek advice from their superiors and co-workers and to complete this activity in their own words and according to their own interpretation.

Timeframe: 1h 30min

Chapter 4

After completing this chapter, the learner will be able to:

Recognise eroded areas and potential soil erosion and carry out minor control measures

Timeframe

You have to complete this section as follows:

Total time	***Theory***	***Practical***
5h	3h 30min	1h 30min activities

1. Introduction

Facilitator Tip

Lead a general class discussion about the impact of agriculture on the environment. Encourage participation from learners.

Farming activities have a direct impact on the environment. This impact may be positive or negative, depending on how proactive and conservation-conscious the farmer is.

The following are examples of poor farming practices that have a negative affect on the environment:

- Over grazing of animals
- Poor irrigation practices
- Inappropriate farming techniques, such as deep ploughing two times per year to produce annual crops
- Intensive farming practices, such as the lack of crop rotation
- Planting crops down the contour instead of along it
- Destruction of tree and plant cover

2. Soil Erosion

Facilitator Tip

Most learners would have encountered soil erosion of some sort by this time. Make sure the sources of erosion are understood and that techniques to prevent the erosion are suggested. Show the effects of erosion by performing mini-experiments, such as:

- Show water erosion by building a small heap of sand over a heap of stones and then flushing water from a hose over it.
- Show wind erosion by placing a hand full of salt or powder in front of a fan.

Soil erosion is a serious problem throughout the world. South Africa is a relatively dry country compared to many others. Poor soil management results in soil loss from arable lands, into rivers, which eventually finds it way into the ocean.

Soil erosion is caused by water and wind.

2.1. Water Erosion

The biggest cause of soil erosion is water. When a drop of water hits soil with no plant cover, it impacts on the soil is like a bullet. This action causes the soil grains to loosen. The loose soil grains are suspended in the water, and runs off with the water.

Nutritious topsoil is always first to be removed as it is the top layer of soil. Without topsoil, plants cannot grow and the land becomes desert-like. Without plant cover, the effect of water is multiplied, and the result is desertification, meaning that the area literally becomes a desert.

Water erosion also affects downstream areas, causing flooding and silting up dams because of the suspended soil particles.

The flow of the water causes the formation of channels, and eventually dongas and gullies. Channels occur on steep slopes because of the irregularities in the land. Water finds hollows that run into one another and slowly deepen to form miniature dongas.

Dongas usually occur near the bottom of slopes and are caused by runoff of water and soil forming a deep channel or gully. A deep channel eventually opens at the bottom end of the slope and slowly works its way from the channel, deepening and widening it, until a donga is formed.

2.2. Wind Erosion

Wind erodes the soil by blowing away loose soil particles if the soil is left bare. Wind erosion is not a big issue in citrus production, but is prevalent in arid areas, and around animal watering holes.

3. Preventing Soil Erosion

Soil erosion can be prevented by employing the following measures:

- Arable land should not be left bare
- Make and use contours when ploughing and planting
- Plant windbreaks
- Ensure the soil is rich in humus.
- Allow indigenous plants to grow along rivers and in gullies
- Conserve wetlands, grasslands and forests
- Perform minimum or no tillage
- Encourage water infiltration by improving the soil structure
- Reduce water runoff
- Ensure there is a protective plant cover
- Plant ground covers to stabilise soil
- Build gabions and install shade cloth barriers in gullies to prevent soil washing away
- Mulch soil to prevent dust particles from blowing away

Although weeds compete with citrus trees for water and food, and is therefore controlled in an orchard, a good grass covering provides protection against excessive run-off and the resultant soil erosion. Careful management of irrigation also contributes to controlling soil erosion.

The formation of gullies and dongas can be prevented by:

- Diverting waterways to reduce the intense water flow
- Planting grass in waterways to prevent soil erosion

Once a gully has formed, the land can be rehabilitated by shoring it up with old tree trunks, etc.

Summary

This is an opportunity to check the progress that learners have made.

Allow time for the learners to read through the summary and to gauge their own progress. Make sure that each and every learner gets and opportunity to ask questions.

Chapter 4

- Soil erosion is caused by water or wind.
- Gullies and dongas are formed as a result of soil erosion.
- Soil erosion can be prevented and controlled by maintaining a grass cover in orchards and controlling irrigation by managing irrigation to prevent excessive runoff.
- Dongas and gullies can be rehabilitated by diverting water ways and by shoring them up.

Complete activity 5 in the **Learner Workbook**.

Activity 5 – Practical Project

Allow learners to spend time on the farm to complete the activity. Encourage the learners to use this opportunity to do self-evaluation and to complete the activity as much as possible on their own.

Timeframe: 1h 30min

Chapter 5

After completing this chapter, the learner will be able to:

Prevent the spread of veld fires by making firebreaks and/or fireguards on the farm

Timeframe

You have to complete this section as follows:

Total time	***Theory***	***Practical***
21h 30min	3h 30min	3h activities 15h work constructing firebreaks

1. Introduction

Facilitator Tip

Hold a class discussion about the devastation that fire causes in agriculture and to natural fauna and flora. Allow learners the opportunity to share their personal experiences and to ask questions.

Discuss as many methods of preparing firebreaks as possible. Emphasise the need to clear vegetation and to keep any flammable materials away from firebreaks.

Fire poses a huge risk to any commercial farming operation. Citrus orchards that have taken a long time to become established and productive can be seriously damaged or destroyed in a short space of time. Procedures must therefore be in place to prevent fires from spreading.

A firebreak, also referred to as a fireguard, is a strip of land that has been cleared of trees, bushes, and any other combustible material in order to prevent a fire from spreading.

The firebreak forms a boundary around orchards that is able to hinder a runaway fire. However, a firebreak cannot stop every veld fire and it is possible that a fire can jump a firebreak under very windy and dry conditions. A firebreak is however useful to stop most fires, to provide a line from which to combat a fire by back burning, and to protect property. Roads between orchards form natural firebreaks.

2. Building Firebreaks

All landowners are required to prepare firebreaks on their side of a boundary between two farms, and it is good practice to have firebreaks anywhere on a farm where orchards neighbours natural vegetation.

There are general guidelines that must be followed when preparing firebreaks, being:

- The firebreak must be wide and long enough to have a reasonable chance of stopping a veld fire.
- The firebreak must not cause soil erosion.
- The firebreak should be reasonably free of inflammable material.
- It is advisable for farmers to remove protected plants from the path of a firebreak before undertaking the building of a firebreak. These plants must be transplanted where possible.

The method used to prepare a firebreak depends on the conditions around the orchards, and on the equipment that is available. Grading and burning are the most common methods used.

- Burning
- Grading

2.1. Burning

Facilitator Tip

Alert learners to the dangers of burning and to the responsible methods in which firebreaks can be burnt. Ensure that learners are aware of reporting fires and are able to contact their local fire department.

Burning is most often used in combination with slashing. The vegetation is slashed and kept short to keep the flammable material to a minimum. As the dry season approaches, and the threat of veld fires increases, farmers may then burn this area to further reduce the flammable material. In some cases, herbicide is sprayed on the slashed vegetation before it is burnt.

Tall, uncut vegetation is not often burnt on a farm, as this can cause a runaway fire in itself. The vegetation must be reduced to a minimum through slashing and using herbicides before it is burnt.

If the firebreak is to be burnt on a border with a neighbouring farm, it is good practice to contact the neighbour to agree to burn on mutually acceptable dates. Inform the Fire Protection Association of the agreed upon dates. Never burn a firebreak on a windy day.

It is essential that any material that might burn is removed. Any paper, rubber, grass, dead plant material, and flammable chemicals must be removed from the area to prevent the spread of fires.

2.2. Grading

Facilitator Tip

Many learners would have been exposed to grading by hand, where vegetation is removed and paths are formed by compacting the soil or placing stones. Alert learners to the use of machinery in this task.

Grading is generally used to make dirt roads on farms, and can also be used successfully to level and compact the soil around orchards to form firebreaks.

It takes longer to make a firebreak through grading than through burning, but it is safer to use this method especially where the firebreak is between an orchard and natural vegetation.

Facilitator Tip

Summary

This is an opportunity to check the progress that learners have made.

Allow time for the learners to read through the summary and to gauge their own progress. Make sure that each and every learner gets and opportunity to ask questions.

Summary

Chapter 5

- Fire poses a great threat to all farming operations.
- A firebreak, or fireguard, is a strip of land that has been cleared of trees, bushes, and any other combustible material in order to prevent a fire from spreading.
- Firebreaks are most commonly made by grading and burning.

Practical

Complete activity 6 in the **Learner Workbook**.

Facilitator Tip

Activity 6 – Practical Project

Alert learners to the need for them to arrange for and participate in the making of a firebreak on a farm, and to base their answers to this activity on this experience. It is recommended that learners spend about 15 hours in the making or constructing of firebreaks.

Timeframe: 3h

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