Learner Guide
Primary Agriculture

Understand how sustainable farming systems conserve natural resources

My name: ........................................
Company: ........................................
Commodity: .............................. Date: .................

The availability of this product is due to the financial support of the National Department of Agriculture and the AgriSETA. Terms and conditions apply.
Before we start...

Dear Learner - This Learner Guide contains all the information to acquire all the knowledge and skills leading to the unit standard:

**Title:** Understand how sustainable farming systems conserve natural resources  
**US No:** 116169  
**NQF Level:** 1  
**Credits:** 4

The full unit standard will be handed to you by your facilitator. Please read the unit standard at your own time. Whilst reading the unit standard, make a note of your questions and aspects that you do not understand, and discuss it with your facilitator.

This unit standard is one of the building blocks in the qualifications listed below. Please mark the qualification you are currently doing:

<table>
<thead>
<tr>
<th>Title</th>
<th>ID Number</th>
<th>NQF Level</th>
<th>Credits</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Certificate in Animal Production</td>
<td>48970</td>
<td>1</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>National Certificate in Mixed Farming Systems</td>
<td>48971</td>
<td>1</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>National Certificate in Plant Production</td>
<td>48972</td>
<td>1</td>
<td>120</td>
<td></td>
</tr>
</tbody>
</table>

Please mark the learning program you are enrolled in:

Your facilitator should explain the above concepts to you.

You will also be handed a Learner Workbook. This Learner Workbook should be used in conjunction with this Learner Guide. The Learner Workbook contains the activities that you will be expected to do during the course of your study. Please keep the activities that you have completed as part of your Portfolio of Evidence, which will be required during your final assessment.

You will be assessed during the course of your study. This is called *formative assessment*. You will also be assessed on completion of this unit standard. This is called *summative assessment*. Before your assessment, your assessor will discuss the unit standard with you.

**Enjoy this learning experience!**
How to use this guide …

Throughout this guide, you will come across certain re-occurring “boxes”. These boxes each represent a certain aspect of the learning process, containing information, which would help you with the identification and understanding of these aspects. The following is a list of these boxes and what they represent:

**What does it mean?** Each learning field is characterized by unique terms and definitions – it is important to know and use these terms and definitions correctly. These terms and definitions are highlighted throughout the guide in this manner.

**Activity**

You will be requested to complete activities, which could be group activities, or individual activities. Please remember to complete the activities, as the facilitator will assess it and these will become part of your portfolio of evidence. Activities, whether group or individual activities, will be described in this box.

**Examples**

Examples of certain concepts or principles to help you contextualise them easier, will be shown in this box.

**How am I doing?**

The following box indicates a summary of concepts that we have covered, and offers you an opportunity to ask questions to your facilitator if you are still feeling unsure of the concepts listed.

**My Notes …**

You can use this box to jot down questions you might have, words that you do not understand, instructions given by the facilitator or explanations given by the facilitator or any other remarks that will help you to understand the work better.

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What will I be able to do?

When you have achieved this unit standard, you will be able to:

- Explain the purpose of maintaining and increasing biodiversity,
- Understand the role of natural resource management in sustainable agricultural practices
- Apply general agricultural and conservation regulations to strengthen sustainable agricultural practices
- Participate in, undertake and plan farming practices with a knowledge of the environment

Learning Outcomes

When you have achieved this unit standard, you will be able to:

- Basic principles of natural resources management.
- Components of the water cycle.
- Components of ecosystems.
- Components of an energy cycle.
- Basic principles of sustainability.
- Local veld types and their carrying capacities.
- Classification of fauna and flora relevant to the direct environment.
- Alien species relevant to the direct environment.
- Basic environmental patterns and processes.
- Local weather and climate, and seasonal conditions of the area.
- Basic local ecosystems.
- Importance of biodiversity in local farming systems.
- Sources of water.
- Sources of energy (renewable and non-renewable).
- Types of pollution.
- Basic fire fighting rules.

What do I need to know?

No learning is required to be in place.

My Notes ...

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Introduction

Agriculture has been part of human activities for thousands of years and it continues to provide a major source of income and/or livelihood for rural communities.

Agriculture has changed dramatically, especially since the end of World War II. Food and fibre production has increased due to new technology, mechanisation, increased use of chemicals, specialisation and state policies which encourages maximum production. These changes have resulted in fewer farmers requiring fewer labours to produce large requirements of food and fibre in South Africa.

Although there are economic benefits to these changes, the other ‘costs’ are very high. These include:

♦ Loss of topsoil,
♦ Water pollution,
♦ Soil pollution,
♦ Soil salination,
♦ Fewer family farms,
♦ Decrease in quality of life for farm workers,
♦ Increased production costs, and
♦ Social dysfunction in rural communities.

A focus on sustainable farming practices considers not just environmental and social aspects, but also looks at economic issues and political structures within the whole farming system.

Agriculture as a business forms part of the country’s economy which includes production, manufacturing and distribution of food and food products.
The impact of farming operations and practices on the environment

After completing this session, you should be able to:

SO 1: Demonstrate an understanding of the impact of farming operations and practices on the environment.

In this session we explore the following concepts:

♦ The farmer’s responsibilities of soil, water and animal-care are explained.
♦ Elements of farming operations affecting the environment are identified and described. These effects include soil erosion, water pollution and wastage, invasive plants, fire, flood and population encroachment, endangered plants and fauna.
♦ Invasive and endangered fauna and flora species that occur on the farm or its direct environment listed and identified.
♦ Environmentally friendly agricultural practices are explained in terms of soil and water conservation.

1.1 The farmer's responsibilities of soil, water and animal-care

The two most significant natural resources cover the entire earth’s surface are soil and water. All life on earth depends upon these resources as a direct or indirect source of food and/or habitat. Plants are rooted in the soil and obtain nutrients (nourishing substances) from it. Animals get nutrients from either eating the plants or from other animals that ate plants for food. Soil and water provide habitats for organisms such as seeds, spores, insects, and worms. The contents of soil and water change constantly and there are many different kinds of soil and levels of water quality. Soil formation is a very slow process and is destroyed easily, so it must be conserved in order to continue to support life.

Soil is made up of four parts: air, water, minerals, and organic material. Air and water provide nutrients to plants so they can make food for themselves. Organic matter, also known as humus, is made of plant and animal remains in various stages of decay. Minerals are the clay, sand, and silt particles. The mineral content determines the soil type.
Farmers have very important jobs growing food and fibre for the world. If we did not have farmers, we would have to grow our own food and fibre. However, a farmer's job consists of many more responsibilities than growing food or fibre. They must also take good care of our soil and water resources so we can continue to grow enough food to feed everyone. If the correct nutrients are not present in the soil, the levels of these nutrients need to be adjusted so the farmer can grow a healthy crop. By adding soil nutrients (e.g. fertilisers) and practicing crop rotation, farmers replace nutrients that have been removed through the process of leaching and growing plants.

Farmers also make sure there is a high level of organic matter in cultivated soils. This can only be maintained if the farmer ensures that biodiversity is maintained and that eco-systems do not become damaged. This means that farmers have a responsibility to take care of the natural fauna (animals) and indigenous flora (plants) of the area where they are conducting their farming operation.

Please complete Activity 1: Brainstorm with your group and record your conclusions in your learner workbook.

**1.2 Elements of farming operations affecting the environment**

<table>
<thead>
<tr>
<th>Soil erosion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erosion is a serious problem for productive agricultural land and for water quality. Controlling the sediment must be an integral part of any soil management system to improve water and soil quality. Eroded topsoil can be transported by wind or water into streams and other waterways. Sediment is a product of land erosion and derives largely from sheet and rill erosion from upland areas, and to a lesser degree, from cyclic erosion activity in gullies and drainage ways.</td>
</tr>
<tr>
<td>Many studies indicate that soil erosion has largely resulted in decreases in soil productivity</td>
</tr>
</tbody>
</table>
The rapid pace of urbanisation, industrialisation as well as agricultural activities has made environmental pollution a growing concern globally. Off all the systems exposed to contaminants, ground water has received little attention in the past because of the common belief that ground water was pristine.

Ground Water Pollution is usually traced back to four main origins industrial, domestic, agricultural and over exploitation. Excessive application of fertilizers for agricultural development coupled with over-irrigation is also responsible for ground water pollution.

Increased mineral salts in rivers may arise from several sources:
♦ pollution by mining waste waters
♦ pollution by certain industrial waste waters
♦ increased evaporation in the river basin (mainly in arid and semiarid regions)

Cultivation with Agrochemicals

Agricultural land use and cultivation practices have been shown to exert major influences on groundwater quality. Under certain circumstances, serious groundwater pollution can be caused by agricultural activities the influence of that may be very important because of the large areas of aquifer affected. For example, if surface run-off is polluted by agricultural chemicals and percolates into the ground, where it becomes part of an underground aquifer, the polluted water will contaminate all the water in the aquifer.

Poor water quality will directly affect the agricultural production capacity for both crops and for animal production.

Invasive alien species are causing billions of Rands of damage to South Africa’s economy every year, and are the single biggest threat to the country’s biological biodiversity.

Invasive alien species are plants, animals and microbes that are introduced into countries, and then out-compete the indigenous species.

Invasive alien plants (IAPs) pose a direct threat not only to South Africa’s biological diversity, but also to water resources, the ecological functioning of natural systems and the productive use of land. They increase the impact of fires and floods and soil erosion. Invasive alien plants can consume enormous amounts of water intended for more productive uses. Invasive aquatic plants, such as the water hyacinth, affect agriculture, fisheries, transport, recreation and water supply.

Fire is a hazard in many regions of South Africa. Fires can result in:
♦ loss of life, and or disability, due to vegetation fires;
♦ loss of housing and possessions when thatched or wooden dwellings ignite, and
♦ loss of grazing, crops, livestock and natural resources.

Of equal – if not greater – importance is the “knock-on” effect of wild fires on rural economies; resulting in the loss of homesteads, economically sustaining natural resources and often family members.
**Flood**

Like fire, flood causes direct losses as follows:

The direct losses results in:

- loss of life, and disability, due to drowning;
- loss of housing and possessions when houses and dwellings are destroyed or washed away;
- Damage to infrastructure and structures which are not only expensive to repair but can inhibit the functioning of an enterprise until repairs are completed (such as a bridge that is washed away), and
- loss of grazing, crops, livestock and natural resources.

Of equal – if not greater – importance is the “knock-on” effect of floods on agricultural production and its contribution to the national economy due to reduced crop size and / or capacity to recover from these floods.

**Population encroachment**

As the world population increases, a difficult scenario develops. There is higher demand for “living space” and more and more people stream to cities in order to try and find viable economic livelihoods. We call this “urbanisation”.

But as cities grow through urbanisation, the land that might have been utilised for either agricultural purposes, forestry or naturally occurring vegetation and eco-systems, shrinks.

Simultaneously the demand for water increases, whilst the output of potential emissions and pollution increases. Water is already a limited resource in South Africa.

Then there is also a higher demand for food, which leads to an increase in Agriculture – especially for crop production. But whilst this might sound like a good thing for farmers, we have to remember, that for every hectare of additional Agricultural land that we have to use, we also need viable soil and enough water in order to farm sustainably. If we exhaust our soil and water resources and damage all the natural ecosystems, then we will cause a scenario whereby both our soil and water resources will become depleted resources making agricultural production a unsuccessful venture.

More agriculture also leads to higher demand for water, whilst immediately increasing the risks to water quality through pollution, run-off and salination due to irrigation and use of agro-chemicals.
Biodiversity describes the variety of life in an area, including the number of different species, the genetic wealth within each species, the interrelationships between them, and the natural areas where they occur.

An immensely rich species diversity is found in South Africa unfortunately this natural wealth is under extreme pressure resulting from human demands placed on the environment through economic development, agriculture and urbanisation. Invasive alien vegetation and the trade in wildlife also contribute to the problem.

The conservation status of a plant or animal species is described by the following terms:

- **EXTINCT**: a species for which there is a historical record, but which no longer exists.
- **ENDANGERED**: a species in danger of extinction, and whose survival is unlikely if the factors causing its decline continue.
- **VULNERABLE**: a species which it is believed will move into the endangered category if the factors causing its decline continue.
- **RARE**: a species with small populations, which are not yet vulnerable or endangered, but which are at risk.

The term **THREATENED** is commonly used as a collective description for species which are endangered vulnerable or rare.

Some species are **ENDEMIC**, i.e. they are restricted to one region and occur nowhere else. A threatened endemic is a conservation priority.

Living things do not exist independently of each other, or the non-living environment. They depend on one another in a variety of ways: think, for example, of a food chain. Together with the non-living parts of our environment (e.g. soil, water, air), living things form essential life-support systems such as the water cycle, the carbon cycle and several other nutrient cycles. The pool of life is therefore much more than the sum of its parts.
1.3 Endangered fauna and flora on the farm or direct environment

There are more than 22,000 different species of seed plants indigenous to Southern Africa. These are arranged into about 2,180 genera, which in turn form part of 227 families. We have described some of the more popular plants on this site.

For thousands of years the plants of Southern Africa provided the inhabitants of the region with many of the essentials of life: food, shelter, utensils, medicine, etc.

Some plants have become threatened through over-use or habitat destruction and these plants must be protected. In fact, some species are protected by law and require permits to be grown (such as cycads). When such plants grow on a farm it is the farmer’s responsibility to ensure that farming activities do not undermine the plants’ chances of survival.

Similarly, some animals have become threatened or endangered either through excessive hunting or loss of habitat and these species must also be protected.

1.4 Declared Weeds and Alien Invaders

South Africa has a long history of problem plants which have been variously called 'weeds', 'pest plants', 'plant invaders', 'invasive plants', 'bush encroachers', 'naturalised exotics or aliens', 'environmental weeds', 'transformers' and others. The terms have been used to describe both indigenous plants (native, belonging to South Africa) and non-indigenous plants (exotic, alien, introduced to South Africa). Non-indigenous or alien plants were first introduced to South Africa between one and two thousand years ago. These were plants mainly of central and northern African origin and were associated with human activities.

'Weeds' are generally referred to as plants that grow where they are not wanted. Many indigenous pioneering species are weeds of disturbed sites such as roadsides, overgrazed land and waste places. Alien weeds occur in the same disturbed sites and are also common in cultivated lands, planted pastures and lawns. 'Environmental weeds' are alien plants that invade natural vegetation.
'Invasive plants', 'plant invaders' or 'invader plants' usually refers to alien plants that are capable of reproducing and spreading without the direct assistance of humans. The most aggressive invaders can spread far from the parent plants and have the capacity to cover large tracts of land. In South Africa the term 'invasive' has sometimes been applied to indigenous species whose distribution or density has increased in response to man-induced changes in the environment. Indigenous woody species that invade overgrazed land are referred to as 'bush encroachers'.

**Category 1 Plants**
This is the strictest category. These plants may not occur on any land or inland water surface other than in a biological control reserves. Except for the purposes of establishing a biological control reserve, one may not plant, maintain, multiply or propagate such plants, import or sell or acquire propagating material of such plants except with the written exception of the executive officer.

**Category 2 Plants**
These are plants with a commercial application and may only be grown in demarcated areas (or biological control reserves). See the Government Gazette listed below for details relating to demarcated areas. Other provisions of category 1 apply.

**Category 3 Plants**
The regulations regarding these plants are the same as for category 1, except that plants already in existence at the time of the commencement of these regulations are exempt, unless they occur within 30 metres of a 1: 50 year flood line of river, stream etc.

### 1.5 List of declared weeds and invaders of South Africa

The South African Botanical Institute’s list of declared weeds and invaders of South Africa.
## Category 1
### Plants
- Ant Tree
- American bramble
- Australian Albizia
- Australian cheesewood
- Australian myrtle
- Azolla
- Balloon vine
- Banana poka
- Bananadilla
- Barbados gooseberry
- Bloodberry
- Blue echiun
- Blue passion flower
- Bridal wreath Steenis
- Bugweed
- Burweed
- Camel thorn bush
- Canadian water weed
- Cat's claw creeper
- Chromolaena
- Chandeliers plant
- Cherry pie Lantana - all seedbearing forms
- Chilean cestrum
- Clover broomrape
- Cochineal prickly pear
- Common dodder
- Common thorn apple
- Crimson cestrum
- Crofton weed
- Dense-thorned bitter apple
- Dense water weed
- Devil's pumpkin
- Downy thorn apple
- Drooping prickly pear
- Durban guava
- Eglandine
- European gorse
- False lebbeck
- Feathertop
- Field bindweed
- Fountain grass Excl. sterile cultivar "Rubrum"
- Giant reed
- Golden wattle
- Granadina
- Harrisia cactus
- Hoary candaria
- Imbricate cactus
- Imbricate prickly pear
- Indian laurel
- Indian shot excl. hybrid cultivars
- Indigo berry
- Inkberry
- Invading ageratum
- Jointed cactus
- Kahili ginger lily
- Kangaroo wattle Acacia paradoxa DC.
- Kariba weed And other species of the family Salviniaceae
- Kudzu vine
- Lantana - all seedbearing forms
- Large cocklebur
- Large flowered prickly pear
- Large round-leaved prickly pear
- Large thorn apple
- Lebbeck tree
- Lesser broomrape
- Long - leaved wattle
- Long spine cactus
- Lucerne dodder
- Madeira vine
- Mauritius thorn
- Mexican ageratum excl. cultivars
- Mexican sunflower
- Mission prickly pear excl. spineless cactus pear cultivars and selections
- Mistflower
- Montpellier broom
- Moon cactus
- Moth catcher
- Nassella tussock
- Oleander excl. sterile, double-flowered cultivars
- Orange cestrum
- Pampas grass
- Pampas excl. sterile cultivars
- Parrot's feather
- Parthenium
- Patterson's curse
- Pepper - cress
- Pest pear of Australia
- Pom pom weed
- Potato creeper
- Purple loosestrife
- Queen of the Night
- Red ginger lily
- Red sesbania
- Red sunflower
- Red water fern
- Rivina
- Rock hakea
- Rosea cactus
- Saucepan cactus
- Scotch broom
- Scotch thistle.
- Screw - pod wattle
- Silky hakea
- Silver-leaf bitter apple
- Small round - leaved prickly pear
- Spanish broom
- Spanish reed
- Spear thistle
- Spiked water-milfoil.
- Spiny cocklebur
- Stink bean
- Sweetbriar
- Sweet hakea
- Sweet pittosporum
- Sweet prickly pear excl. spineless cactus pear cultivars and selections
- Tickberry Lantana - all seedbearing forms
- Torch cactus
- Tree daisy
- Triplaris
- Water hyacinth
- Water lettuce Category
- Wax tree
- White ginger lily
- White tussock
- White-flowered Mexican poppy
- White top
- Wild tomato
- Wild morning glory
- Wild tobacco
- Yellow bells
- Yellow cestrum
- Yellow ginger lily
- Yellow oleander
- Yellow-flowered Mexican poppy
Understand how sustainable farming systems conserve natural resources

<table>
<thead>
<tr>
<th>Plants</th>
<th>Category 2</th>
<th>Category 3</th>
<th>Multiple categories</th>
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</thead>
<tbody>
<tr>
<td>• Aleppo grass</td>
<td>• Crack willow - Not to be confused with indigenous species</td>
<td>• Patula pine</td>
<td>• Brazilian pepper tree</td>
</tr>
<tr>
<td>• Aleppo pine</td>
<td>• European blackberry</td>
<td>• Port Jackson</td>
<td>• Multiple categories</td>
</tr>
<tr>
<td>• Australian blackwood</td>
<td>• Green wattle</td>
<td>• Radiata pine</td>
<td>• Camphor tree</td>
</tr>
<tr>
<td>• Beefwood (Not for use in dune stabilization)</td>
<td>• Grey ironbark</td>
<td>• Red eye</td>
<td>• Multiple categories</td>
</tr>
<tr>
<td>• Black ironbark</td>
<td>• Grey poplar</td>
<td>• Red ironbark</td>
<td>• Chinese tamarisk</td>
</tr>
<tr>
<td>• Black locust (Only for use as rootstock if authorised by Executive Officer in terms of regulation 15B(10))</td>
<td>• Guava</td>
<td>• Red river gum</td>
<td>• Multiple categories</td>
</tr>
<tr>
<td>• Black wattle</td>
<td>• Honey mesquite</td>
<td>• Rose gum</td>
<td>• Coral Bush</td>
</tr>
<tr>
<td>• Brittle willow (Not to be confused with indigenous species)</td>
<td>• Honey locust - excl. sterile cultivars</td>
<td>• Saligna gum</td>
<td>• Multiple categories</td>
</tr>
<tr>
<td>• Canary pine</td>
<td>• Horsetail tree - not for use in dune stabilization</td>
<td>• Sisal Perrine</td>
<td>• Chir pine</td>
</tr>
<tr>
<td>• Castor - oil plant L</td>
<td>• Johnson grass</td>
<td>• Slash pine</td>
<td>• Cluster pine</td>
</tr>
<tr>
<td>• Chir pine</td>
<td>• Karri</td>
<td>• St. John's wort</td>
<td>• Crack willow - Not to be confused with indigenous species</td>
</tr>
<tr>
<td>• Cluster pine</td>
<td>• Lobolly pine</td>
<td>• Sugar gum</td>
<td>• Eastern blackberry</td>
</tr>
<tr>
<td></td>
<td>• Longifolia pine</td>
<td>• Sweet locust excl. sterile cultivars</td>
<td>• Multiple categories</td>
</tr>
<tr>
<td></td>
<td>• Matchwood poplar</td>
<td>• Tipton weed</td>
<td>• Green wattle</td>
</tr>
<tr>
<td></td>
<td>• Monterey pine</td>
<td>• Velvet mesquite</td>
<td>• Grey ironbark</td>
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<tr>
<td></td>
<td>• Old man saltbush</td>
<td>• Watercress</td>
<td>• Grey poplar</td>
</tr>
<tr>
<td>• Abyssinian' coleus</td>
<td>• Jambolan</td>
<td>• Weeping willow not to be confused with indigenous species</td>
<td>• Guava</td>
</tr>
<tr>
<td>• Australian silky oak</td>
<td>• Japanese wax - leaved privet</td>
<td>• White poplar</td>
<td>• Honey mesquite</td>
</tr>
<tr>
<td>• Bailey's wattle</td>
<td>• Loquat</td>
<td></td>
<td>• Himalayan firethorn</td>
</tr>
<tr>
<td>• Belhambra</td>
<td>• Manatoka</td>
<td></td>
<td>•рак черешное</td>
</tr>
<tr>
<td>• Brazilian guava</td>
<td>• Morning glory</td>
<td></td>
<td>• Silver - leaf cotoneaster</td>
</tr>
<tr>
<td>• Butterfly orchid tree</td>
<td>• New Zealand christmas tree</td>
<td></td>
<td>• Sponge - fruit saltbush</td>
</tr>
<tr>
<td>• Californian privet</td>
<td>• Orchard tree</td>
<td></td>
<td>• Silver wattle Multiple categories</td>
</tr>
<tr>
<td>• Chinese privet</td>
<td>• Peanut butter cassia</td>
<td></td>
<td>• Singapore daisy Multiple categories</td>
</tr>
<tr>
<td>• Chinese wax - leaved privet</td>
<td>• Pear acacia</td>
<td></td>
<td>• Spider gum Multiple categories</td>
</tr>
<tr>
<td>• Common mulberry</td>
<td>• Pepper tree wattle</td>
<td></td>
<td>• Surinam cherry Multiple categories</td>
</tr>
<tr>
<td>• Common privet</td>
<td>• Persian lilac</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Cotoneaster</td>
<td>• Pickerel weed</td>
<td></td>
<td></td>
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<tr>
<td>• Formosa lily</td>
<td>• Rambling cassia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Giant sensitive plant</td>
<td>• Rose apple</td>
<td></td>
<td></td>
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<tr>
<td>• Himalayan firethorn</td>
<td>• Silver - leaf cotoneaster</td>
<td></td>
<td></td>
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<tr>
<td>• Jacaranda excl. sterile cultivar &quot;Alba&quot;</td>
<td>• Sponge - fruit saltbush</td>
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<td></td>
</tr>
</tbody>
</table>
1.6 Environmentally friendly agricultural practices

Soil and water conservation.

Farming activities have a direct impact on the environment; however, this may be a positive or negative depending on how proactive and conservation oriented the farmer is.

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

♦ Over grazing.
♦ Poor irrigation.
♦ Inappropriate farming techniques (i.e. deep ploughing 2/3 times per year to produce annual crops).
♦ Intensive farming practices – the lack of crop rotation.
♦ Planting crops down the contour instead of along it.
♦ Destruction of trees and plant cover.

The genes, species and ecosystems that make up the earth’s biological diversity are important because their loss and degradation diminishes nature. Species other than our own have a right to exist and to retain their place in the world. We do not know how to estimate which species are essential to ecosystem functioning, which are redundant, and which will be the next to flourish as the world changes. When we introduce a new species into an eco-system, the full impact is often not immediately apparent. Invasive species can change entire habitats, making them unsuitable for the original native community.

Safeguarding the earth’s diversity is the best way to maintain our life support system. There is evidence to suggest that the biosphere acts as a self-regulating whole and that diverse systems may be more resilient. Island ecosystems, which have evolved in isolation often have relatively fewer plants, herbivores, carnivores and decomposers to maintain essential processes and are more vulnerable to invasion. On islands around the world species extinction is increasing at an unprecedented rate.
Useful initiatives, which contribute to better management practices and a reduced incidence of biological invasion, are being taken by communities all over the world. Invasive alien species are now a major focus of international conservation concern and the subject of cooperative international efforts, such as the Global Invasive Species Programme (GISP). As awareness grows, people and their communities are able to make informed choices that will have lasting effects on their descendants. We hope that, by raising general awareness, the risks of further harmful invasions will be reduced in future.

There are various definitions and concepts that you might encounter in terms of South African agricultural production and conversion that are important to understand:

| **Aeroponics** | is a hydroponics’ technique involving the use of sprayers, nebulizers, foggers, or other devices to create a fine mist of solution to deliver nutrients to plant roots. Aeroponic techniques are used in the cultivation of high value crops and plant specimens that can offset the high set-up and maintenance costs associated with this method of horticulture. |
| **Aerial topdressing** | is the spreading of fertilisers such as super phosphate over farmland. For spraying of insecticides and fungicides, by air, also called crop dusting. |
| **Agricultural machinery** | is one of the most revolutionary and impactful applications of modern technology. Given the truly elemental human need for food, agriculture has been an essential human activity almost from the beginning, and it has often driven the development of technology and machines. Over the last 250 years, advances in farm equipment have dramatically changed the way people are employed and produce their food worldwide. |
| **Animal husbandry** | is the agricultural practice of breeding and raising livestock. As such, it is a vital skill for farmers and, in some countries in many ways, as much art as it is science. Other countries have strict laws on the qualifications needed to treat animals and ensure that scientific methods are used to care for them. |
### Aquaculture
Aquaculture is the cultivation of the natural produce of water (such as fish or shellfish, algae and other aquatic plants). Mari culture is specifically marine aquaculture, and thus is a subset of aquaculture. Some examples of aquaculture include raising catfish and tilapia in freshwater ponds, growing cultured pearls, and farming salmon in net-pens set out in a bay. Fish farming is a common type.

### Beekeeping
Beekeeping (or apiculture, from Latin apis, a bee) is the practice of intentional maintenance of honeybee hives by humans. A beekeeper may keep bees in order to collect honey and beeswax, or for the purpose of pollinating crops, or to produce bees for sale to other beekeepers. A location where bees are kept is called an apiary.

### Crop rotation
Crop rotation is the practice of growing a series of different type of crops in the same space in sequential seasons to avoid the build-up of pathogens and pests that often occurs when one species is continuously cropped. Crop rotation also seeks to balance the fertility demands of various crops to avoid excessive depletion of soil nutrients. A traditional component of crop rotation is the replenishment of nitrogen through the use of legumes in sequence with cereals and other crops. It is one component of polyculture. Crop rotation can also improve soil structure and fertility by alternating deep-rooted and shallow-rooted plants.

### Concentrated Animal Feeding Operation (CAFO, factory farming)
In agriculture, a Concentrated Animal Feeding Operation (CAFO) is a farm that raises livestock and seeks to maximize production by making highly efficient use of space and other resources. Operating a CAFO is sometimes negatively referred to as factory farming.

CAFOs hold large numbers (up to hundreds of thousands) of animals, often indoors. These animals are typically cows, hogs, or chickens.

### Composting
Compost is the decomposed remnants of organic materials (those with plant and animal origins). Compost is used in gardening and agriculture, mixed in with the soil. It improves soil structure, increases the amount of organic matter, and provides nutrients. Biodegradation is the means by which organic matter is recycled in its environment.
<table>
<thead>
<tr>
<th><strong>Dairy farming</strong></th>
<th>Dairy farming is a class of agricultural, or more properly, an animal husbandry enterprise, raising female cattle for long-term production of milk, which may be either processed on-site or transported to a dairy for processing and eventual retail sale. Most dairy farms sell the male calves borne by their cows, usually for veal production, rather than raising non-milk-producing stock. Many dairy farms also grow their own feed, typically including corn, alfalfa, and hay. This is fed directly to the cows, or stored as silage for use during the winter season. Additional dietary supplements are added to the feed to increase quality milk production.</th>
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<tbody>
<tr>
<td><strong>Detasseling</strong></td>
<td>Detasseling is the act of removing the pollen-producing (or &quot;male&quot;) tassel from a corn (maize) plant. Detasseling is done to breed, or hybridise, two different varieties of corn; the varieties are carefully selected so that the variety bred will exhibit hybrid vigour. By removing the tassels from all plants of one variety, all the grain growing on those plants will be fertilized by the other variety's tassels.</td>
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<tr>
<td><strong>Domestication</strong></td>
<td>Domestication is a phenomenon whereby a wild biological organism is trained to survive in the company of human beings. Domesticated animals, plants, and other organisms are those whose collective behaviour, life cycle, or physiology has been altered as a result of their breeding and living conditions being under human control for multiple generations. Humans have brought these populations under their care for a wide range of reasons: for help with various types of work, to produce food or valuable commodities (such as wool, cotton, or silk), and to enjoy as pets or ornamental plants.</td>
</tr>
<tr>
<td><strong>Fencing</strong></td>
<td>In agriculture, fences are used to keep animals in or out of an area.</td>
</tr>
<tr>
<td><strong>Fertilizers</strong></td>
<td>Fertilizers or fertilisers are compounds given to plants with the intention of promoting growth; they are usually applied either via the soil, for uptake by plant roots, or by foliar spraying, for uptake through leaves. Fertilizers can be organic (composed of organic matter, i.e. carbon based), or inorganic (containing simple, inorganic chemicals). They can be naturally occurring compounds such as peat or mineral deposits, or manufactured through natural processes (such as composting) or chemical processes. Fertilizers typically provide, in varying proportions, the three major plant nutrients (nitrogen, phosphorus, and potassium), the secondary plant nutrients and sometimes trace elements with a role in plant nutrition.</td>
</tr>
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</table>
A **greenhouse** (also called a **glasshouse** or **hothouse**), a building where plants are cultivated. A greenhouse is built of glass or plastic; it heats up because the sun's incoming electromagnetic radiation warms plants, soil, and other things inside the building. Air warmed by the heat from hot interior surfaces is retained in the building by the roof and wall.

**Greenhouse**

In agriculture, **harvesting** is the process of gathering mature crops from the fields. Reaping is the harvesting of grain crops. The harvest marks the end of the growing season, or the growing cycle for a particular crop. **Harvesting** in general usage includes the immediate post-harvest handling, all of the actions taken immediately after physically removing the crop—cooling, sorting, cleaning, packing—up to the point of further on-farm processing, or shipping to the wholesale or consumer market.

Harvest timing is a critical decision that balances the likely weather conditions with the degree of crop maturity. Weather events like frost, and unseasonably warm or cold periods, affect yield and quality. An earlier harvest date may avoid damaging conditions, but result in poorer yield and quality. Delaying harvest may result in a better harvest, but increases the risk of weather problems. Timing of the harvest often involves a significant degree of gambling.

On smaller farms with minimal mechanization, harvesting is the most labour-intensive activity of the growing season. On large, mechanized farms, harvesting utilizes the most expensive and sophisticated farm machinery, like the combine harvester.

**Harvest**

In agriculture and gardening, **hybrid seed** is seed produced by artificially cross-pollinated plants. Hybrids are bred to improve the characteristics of the resulting plants, such as better yield, greater uniformity, improved colour, disease resistance, and so forth. Today, hybrid seed is predominant in agriculture and home gardening, and is one of the main contributing factors to the dramatic rise in agricultural output during the last half of the 20th century. Hybrid seed cannot be saved, as the seed from the first generation of hybrid plants does not reliably produce true copies, therefore, new seed must be purchased for each planting.

**Hybrid seed**

**Hydroponics** is the growing of plants without soil. A variety of techniques exist.

**Hydroponics**

---

**Greenhouse**

**Harvest**

**Hybrid seed**

**Hydroponics**
<p>| <strong>Integrated Pest Management (IPM)</strong> | In agriculture, <strong>Integrated Pest Management</strong> (IPM) is a pest control strategy that uses an array of complementary methods: natural predators and parasites, pest-resistant varieties, cultural practices, biological controls, various physical techniques, and pesticides as a last resort. It is an ecological approach that can significantly reduce or eliminate the use of pesticides. See Fig 1.1. |
| <strong>Irrigation</strong> | <strong>Irrigation</strong> (in agriculture) is the replacement or supplementation of rainfall with water from another source in order to grow crops. In contrast, agriculture that relies only on direct rainfall is sometimes referred to as dry land farming. |
| <strong>Livestock</strong> | <strong>Livestock</strong> are domesticated animals intentionally reared in an agricultural setting to make produce such as food or fibre, or for their labour. Livestock include pigs, cattle, goats, deer, sheep, yaks and poultry. The type of livestock reared varies worldwide and depends on factors such as climate, consumer demand, native animals, local traditions, and land type. |
| <strong>Market gardening</strong> | <strong>Market gardening</strong> as a business is based on providing a wide range and steady supply of fresh produce through the local growing season. Many different crops and varieties are grown, in contrast with large, industrialized farms, which tend to specialize in high volume production of single crops, a practice known as monoculture. Market gardening also employs more manual labour and gardening techniques, compared to large-scale mechanized farming. Because production is relatively low-volume, sales are often through local fresh produce outlets, such as on-farm stands, farmers' markets, community-supported agriculture subscriptions, restaurants and independent produce stores. |
| <strong>Mechanised agriculture</strong> | <strong>Mechanised agriculture</strong> is the process of using agricultural machinery in order to massively increase output. In modern times, machinery has replaced many jobs formerly carried out by men or beasts such as horses, donkeys or oxen. |
| <strong>Monoculture</strong> | In agriculture, &quot;<strong>monoculture</strong>&quot; describes the practice of cultivating the same species of crop year after year on the same piece of land; a common practice in commercial agricultural. Modern agriculture relies on standardisation on a single cultivar so that the technology for tilling, planting, pest control, and harvesting, can be used over large geographical areas to obtain an economy of scale. |</p>
<table>
<thead>
<tr>
<th><strong>Topic</strong></th>
<th><strong>Description</strong></th>
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<tr>
<td>No-till farming</td>
<td>In no-till farming the soil is left intact and crop residues are left in the fields. Variations of the conservation tillage method involve some working of the soil with attention paid to keeping soil compaction and carbon loss at a minimum. These variations include <strong>reduced tillage</strong>, in which small strips may be ploughed to allow space for planting seeds. Other terms, such as <strong>incomplete tillage</strong> and <strong>minimal tillage</strong> may be used.</td>
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<tr>
<td>Organic farming</td>
<td><strong>Organic farming</strong> is a form of agriculture that relies on ecosystem management and attempts to reduce or eliminate external agricultural inputs, especially synthetic ones. It is a holistic production management system that promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity.</td>
</tr>
<tr>
<td>Plant breeding</td>
<td><strong>Plant breeding</strong> has been practiced for thousands of years, since near the beginning of human civilization. It is now practiced worldwide by government institutions and commercial enterprises. International development agencies believe that breeding new crops is important for ensuring food security and developing practices of sustainable agriculture through the development of crops suitable for their environment.</td>
</tr>
<tr>
<td>Permaculture</td>
<td><strong>Permaculture</strong> is a design system which aims to create sustainable habitats by following nature's patterns. Permaculture can best be described as an ethical design system applicable to food production and land use, as well as community building. It seeks the creation of productive and sustainable ways of living by integrating ecology, landscape, organic gardening, architecture and agro forestry.</td>
</tr>
<tr>
<td>Pollination</td>
<td><strong>Pollination Management</strong> is the label for horticultural practices that accomplish or enhance pollination of a crop, to improve yield or quality, by understanding of the particular crop's pollination needs, and by knowledgeable management of colonisers, pollinators, and pollination conditions.</td>
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</table>
**Precision farming** or **precision agriculture** is an agricultural concept relying on the existence of *in-field variability*. It requires the use of new technologies, such as global positioning (GPS), sensors, satellites or aerial images, and information management tools (GIS) to assess and understand variations. Collected information may be used to more precisely evaluate optimum sowing density, estimate fertilizers and other inputs needs, and to more accurately predict crop yields. Application of precision farming concepts is usually considered related to sustainable agriculture. It seeks to avoid applying same practices to a crop, regardless of local soil/climate conditions and may help to better assess local situations of disease or lodging.

Precision farming may be used to improve a field or a farm management from several perspectives:
- **agronomical perspective**: adjustment of cultural practices to take into account the real needs of the crop rather (e.g., better fertilisation management)
- **technical perspective**: better time management at the farm level (hydroponics farming)
- **environmental perspective**: reduction of agricultural impacts (better estimation of crop nitrogen needs implying limitation of nitrogen run-off)
- **economical perspective**: increase of the output and/or reduction of the input, increase of efficiency (e.g. lower cost of nitrogen fertilization practice)

**In agriculture, season extension** refers to anything that allows a crop to be cultivated beyond its normal outdoor growing season.

Open pollination is the key to seed saving. Plants that reproduce through natural means tend to adapt to local conditions, and evolve as reliable performers, particularly in their localities. The modern trend to hybridised plants interrupts this process. Hybrid plants are artificially cross-pollinated, and bred to favour desirable characteristics, like higher yield and more uniform size. However, the seed produced by the first generation of the hybrid does not reliably produce a true copy of that hybrid (it begins to revert to its parents), or is sterile, and is therefore fairly useless for seed saving.
Seed testing is performed in dedicated laboratories by trained and usually certified analysts. The tests are designed to evaluate the quality of the seed lot being sold. Several tests are done:

Germination test: Reports the percentage of seed that germinated. Tests are usually made in 200 or 400 seed samples.

Purity test: The percentage of seed described on the label that is actually found in the quantity of seed.

TZ test: A test for viability that involves soaking the seed in a tetrazolium solution, cutting the seed open, and looking for a colour change in the seed embryo.

Weed test: Examines a sample of seed and identifies every seed that is different from the seed that is different from the labelled seed kind.

Subsistence farming is a mode of agriculture in which a plot of land produces only enough food to feed the family working it. Depending on climate, soil conditions, agricultural practices and the crop grown, it generally requires between 1,000 and 40,000 m² (0.25 and 10 acres) per person.

In agriculture, succession planting refers to several planting methods that increase crop availability during a growing season by making efficient use of space and timing.

There are four basic approaches, that can also be combined:

Two or more crops in succession: After one crop is harvested, another is planted in the same space. The length of the growing season, climate, and crop selection are key factors. For example, a cool season spring crop could be followed by a heat-loving summer crop.

Same crop, successive plantings: Several smaller plantings are made at timed intervals, rather than all at once. The plants mature at staggered dates, establishing a continuous harvest over an extended period. Lettuce and other salad greens are common crops for this approach.

Two or more crops simultaneously: Non-competing crops, often with different maturity dates, are planted together in various patterns. Intercropping is one pattern approach; companion planting is a related, complementary practice.

Same crop, different maturity dates: Several varieties are selected, with different maturity dates: early, main season, late. Planted at the same time, the varieties mature one after the other over the season.
Sustainable agriculture integrates three main goals: environmental stewardship, farm profitability, and prosperous farming communities. These goals have been defined by a variety of disciplines and may be looked at from the vantage point of the farmer or the consumer. To some it is a means of continuing agriculture as usual with increased care for these three factors, while for others it is a deeper commitment to practicing agriculture in a manner that accords with natural flows. The latter is considered the only real form of sustainability while the former is a practical approach for gradual improvements, which in themselves introduce other negative factors that require further modifications.

Vegetable farming is the cultivation of crops for consumption purposes, e.g., cabbages, tomatoes, onions, butternuts, etc. They are traditionally grown in contour rows, taking into account conservation measures and allows for machinery to cultivate the fields, resulting in increased efficiency and output.

Tillage, or cultivation is the agricultural preparation of the soil. Primary tillage loosens the soil and mixes in fertilizer and/or plant material, resulting in soil with a rough texture. Secondary tillage produces finer soil and sometimes shapes the rows. It can be done by using various combinations of equipment: plough, disk plough, harrow, dibble, hoe, rotary tillers, sub-soiler, ridge or bed forming tillers, roller.

Tillage can also mean the land that is tilled.

Weed control, a method used to stop weeds from reaching a mature stage of growth when they could be harmful to domesticated plants, sometimes livestock, by using manual techniques including soil cultivation, mulching, and/or herbicides. Prevention of weeds from growing is desirable, but often difficult to achieve, due to the resilient fertilisation and growth patterns of weeds.
Figure 1.1
Beneficial insects that contribute to pest control in an environmentally friendly way.

Please complete Activity 4 in your learner workbook

My Notes ...

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## Concept (SO 1)

<table>
<thead>
<tr>
<th>I understand this concept</th>
<th>Questions that I still would like to ask</th>
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<tbody>
<tr>
<td>The farmer’s responsibilities of soil-, water- and animal-care are explained.</td>
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<tr>
<td>Elements of farming operations affecting the environment are identified and described.</td>
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<tr>
<td>Effects on the environment include soil erosion, water pollution and wastage, invasive plants, fire, flood and population encroachment, endangered plants and endangered fauna.</td>
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<tr>
<td>Invasive and endangered fauna and flora species are listed and identified.</td>
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<tr>
<td>Fauna and flora species of the farm or direct environment.</td>
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<tr>
<td>Examples of environmentally friendly agricultural practices are explained.</td>
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<td>Soil and water conservation.</td>
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Methods to dispose of, or re-use, farm and domestically generated waste and pollutants

In this session we explore the following concepts:

- Farm generated waste and pollutants are identified and their effects are explained. Domestic waste products include but are not limited to body fluids and solids, wash water and household waste. Farm generated waste and pollutants include fertilisers, chemicals, fuels and lubricants, packaging and product waste.
- Pollution prevention measures are identified and their effects on the environment are explained. These include fertiliser and chemical management, recycling, machinery maintenance and basic rubbish dump management.
- Correct methods of disposal are applied to the waste product and pollutant, including which substances should be taken to a proper disposal facility.

2.1 Wastes and pollutants found on the farm and their effects

Wastes and pollutants, as shown in the list below, are mainly from two possible sources:
Domestic waste

This is any waste that is generated within a domestic household on the farm and as a result of activities in the home environment. They are as follows:

- **Body fluids**: Urine, blood etc. that is discharged via the sanitary system.
- **Domestic solids**: Faecal matter usually discharged through the sanitary system.
- **Both of these can contaminate ground water if allowed to percolate into the soil. It is also possible that pathogens can be passed on to other people.**

Wash water (also known as grey water): Water that has been used for washing clothing, bodies and dishes. It can be used again quite safely, to water trees, for example, provided that it does not contain harmful chemicals such as chlorine- and ammonia-based products (bleach and Handy Andy).

Household waste: This is the organic and inorganic refuse generated in a home. The organic material can easily be recycled via compost heaps, worm farms or given to domestic livestock. Cardboard and paper can be used in trench beds and compost. Glass and tins can be recycled. Plastic is the most hazardous of the materials generally coming from a domestic environment. Many people burn their plastic waste and this releases dioxin into the air (if plastic is burnt at too low a temperature) and this compromises people’s immune and respiratory systems. There is no easy, simple solution to farm waste that cannot be recycled and the most sensible course of action is to have a small landfill site rather than to burn waste.

**Sewerage**

How is waste managed? Sewage is a major source of waste. Most of the sewage is treated, leaving sewage sludge. Recycling sewage sludge to soil provides valuable
nutrients and organic matter. All of our waste has to go somewhere, so we need to find the least harmful way of disposing of it.

The Waste Hierarchy ranks waste disposal options according to their environmental impact:

- **Reduce** - Minimising what we throw away is the best solution to waste management.
- **Re-use** - Needlessly making new products wastes energy and resources.
- **Recycle** - Recycling old products into new ones saves raw materials.
- **Incinerate** - Generating electricity through burning rubbish cuts down the fossil fuels we use.
- **Landfill** - Burying rubbish is the cheapest option, but impacts on the environment the most.

Our waste will always impact in some way on the environment no matter how we dispose of it. Recycling uses energy. Incinerating produces ash and carbon dioxide. Putting waste in landfill means we lose valuable resources. Landfill also produces methane gas as biodegradable rubbish rots down, which can contribute to air pollution and global warming.

In most cases, rural sewage is dealt with in either pit toilets or septic tanks. There are other options available but the most serious consideration is to ensure that sewage does not enter the local water system.

**Farm generated waste**

The waste generated on a farm varies from enterprise to enterprise. However, generally speaking, there are common trends between various farming activities.

- **Fertilisers**

Fertilisers help farmers to increase their crop yields and provide three main nutrients: nitrates, phosphates and potassium (NPK). Fertiliser use has been decreasing steadily since the 1980s. At the same time, crop production has increased, suggesting that farmers are using fertilisers more efficiently. Farmers must be careful when using fertilisers to avoid polluting the environment. It is best to apply fertilisers at the time of year when crops need the extra nutrients the most so that there is less chance of the nutrients being washed away before they are absorbed by the crop.

Fertilisers can be a source diffuse pollution. Diffuse pollution is caused by lots of smaller pollution sources spread over a wide area. The combined effect of many of these small sources of pollution can impact greatly on the environment. Diffuse pollution is different from point source pollution, which comes from distinct points such as piped discharges from factories and sewage treatment works.

Any surplus nutrients washed off farmland can create abnormal nutrient levels in rivers, lakes and the sea, causing a condition known as **Eutrophication**.

What is Eutrophication?
When levels of nutrients in a river, dams or sea are higher than normal this can encourage plants, especially algae, to grow. As the algae grows it uses up the available oxygen in the water, until there is no longer enough to sustain living organisms and the algae, and other organisms, die. The dead and decaying material sinks to the bottom of the body of water, where it undergoes anaerobic decomposition. We call this eutrophication.

What is being done to prevent eutrophication?

We can monitor nutrient levels in dams, boreholes and rivers and discharges to the sea. These measures build on existing good farming practice recommendations, like applying the right levels of fertilisers and manure at the times that best suit the needs of the crop. Using fertilisers efficiently helps reduce environmental pollution and also minimises how much farmers need to spend on chemical fertilisers.

- Chemicals

Pesticides are substances used for controlling or destroying pests. They can be artificial chemical substances, though some natural substances are used to control pests in organic farming. Pesticide use has increased as farming methods have intensified over the last 50 years. Agriculture and horticulture use over 80 per cent of all pesticides.

Over recent years the quantity of pesticides used in agriculture has remained largely unchanged. Many of the more toxic and environmentally damaging products have been banned. Less harmful alternative products have also been introduced.

Pesticides can cause serious environmental problems. Many pesticides are toxic to aquatic life. They can devastate rivers, dams and groundwater if they are used carelessly or not disposed of properly. Scientists have linked declining numbers of farmland birds to the use of pesticides in intensive farming over the last 50 years.

More and more people are becoming conscious of the potential damage of pesticides to their health; it is believed that these chemicals can impair the central nervous system, are suspected to be carcinogenic, can impair the nervous system and accumulate in food and in fatty tissue. Runoff from farm land can lead to pesticides contaminating drinking water supplies - it costs municipalities many millions every year to remove pesticide residues from drinking water, and these costs are passed onto tax payers.

Unlike a river, once an underground water resource is polluted it remains contaminated for many decades and is costly or impossible to clean up.

We can monitor the levels of pesticides in water at a large number of sites each year. We find a range of pesticides in the aquatic environment, including substances such as herbicides, insecticides, animal dips, and wood preservatives. There are lists of approved herbicides, pesticides intended to protect plants. They vary widely in their use, properties and potential impact on the environment. However, the only responsible action we can take is the limited and responsible use of herbicides and pesticides where necessary, but to use alternative methods of either preventing and/or controlling pests and diseases.
Fuels

When used responsibly, fuels do not pose a serious threat to farming operations or the farming environment. There is air pollution generated by every motorised vehicle but this can be kept to minimum levels through regular servicing and maintenance. The storage of fuel on site must be done according to prescribed requirements in order to prevent fire hazards.

Lubricants

When used, stored and disposed of responsibly, lubricants do not pose a serious threat to farming operations or the farming environment. The storage of lubricants on site must be done according to prescribed requirements. It is vital that old containers are disposed of following prescribed methods and procedures.

Packaging

Paper and cardboard packaging can be recycled into the farming system. However, plastic and other non-degradable packaging waste should be disposed of so that it does not pollute. Burning is not a viable option as this causes air pollution that is damaging to human health.

Product waste

In some cases, the waste from production becomes part of the next seasons inputs, such as in the form of an organic layer on the soil. However, various enterprises do generate other wastes. In grape production, where the fruits are being used to make wines, the piles of must, if not integrated back into the ecosystem appropriately, can pollute the environment. Similarly, in the production of animals excessive amounts of manure that is not dealt with appropriately can pollute.
<table>
<thead>
<tr>
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<td>Fertiliser and chemical management, recycling, machinery maintenance and basic rubbish dump management.</td>
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My Notes ...

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Session 3 Practices to maintain and increase biodiversity.

After completing this session, you should be able to:

SO 3: Apply practices to maintain and increase biodiversity.

In this session we explore the following concepts:

♦ The importance of maintaining and increasing natural resources (these include energy, water, soil, plants, animals and fire management practices).
♦ The consequences of not maintaining natural resources.

3.1 What are natural resources

Natural resources are the foundation of not just the farming environment but all life on earth. In terms of the farming environment our natural resources are:

- Air
  
  All plants and animals need oxygen to sustain them and it is important to have good air quality. Part of air as a resource is wind, although this is a resource that can be used, but if there is too much of it, it must be managed.

- Water
  
  Water is essential for all life, and it is most certainly an integral part of farming activities. The water cycle on a farm begins with rainfall and includes infiltration, run-off and underground water reserves.

- Soil
  
  Soil is the foundation of most farming activities, whether the farm focuses on plants or animals. A healthy soil produces healthy plants and these are either harvested and products or utilised by domestic livestock.

- Indigenous plants
  
  Plants are the organisms that absorb sunlight energy and turn it into other forms of energy, which we can then utilise on the farm. Plants exist in communities, and each plant community starts with a pioneer phase and continues to develop until it reaches a stable, climax phase. The climax plant community varies from area to area; the climax plant community near Knysna, for example, are forests, but in the northern parts of the country it is savannah grassland.
Understand how sustainable farming systems conserve natural resources

Primary Agriculture NQF Level 1  Unit Standard No: 116169

The indigenous vegetation on a farm can thus include trees, shrubs, grasses, and bulbs. These plants are useful in a range of ways, from firebreaks, grazing, medicine, timber and thatching.

However an even more important consideration is that indigenous plants fulfil a vital role in the maintenance of ecological services, such as flood and erosion control as well as water purification through wetlands.

Another natural resources that has an impact on farming, but cannot be changed, is climate; the rainfall, temperature range, daylight hours, daylight intensity and wind occurrence in a particular area.

Natural phenomenon that are linked with natural resources are floods and fires.

3.2 Maintaining and increasing natural resources

■ Air

Air quality on a farm is maintained though ensuring that the indigenous vegetation of an area is protected – trees fulfil this function by absorbing carbon dioxide.

■ Water

Water sources must be protected. It is important to understand the rainfall patterns of the area so that water harvesting can be maximised. The way ploughing is done has an impact on the conservation of soil and water; if ploughing is done down slopes rather than on contour it can lead to soil erosion, which has an impact on water quality, and it increases runoff, which means less rainwater is absorbed into the soil.

It is also vital to identify the temporary, seasonal and permanent wetlands of the farm so that these can be protected. Protecting wetlands involves the prevention of grazing in wetlands whilst the ground is wet as the movement of animals on waterlogged soils can cause erosion. If the ‘plug’ of the wetland is disturbed then the entire wetland can become drained.

A wetland can also be damaged if roads and bridges are constructed in the wrong place.

■ Soil

Soil is the foundation of most farming activities, whether the farm focuses on plants or animals. A healthy soil produces healthy plants and these are either harvested and products or utilised by domestic livestock. One of the most important aspects to consider is to prevent soil erosion and this can be done by:

♦ Maintaining appropriate stock levels to prevent overgrazing,
♦ Applying farming techniques such as ploughing along contour lines, and
♦ Maintaining protective plant cover to prevent sheet and wind erosion.
Indigenous plants

It is important to keep stands of indigenous plants on a farm to allow the natural ecology to develop undisturbed. The naturally occurring plants vary from area to area and it is important to know which plants are part of the local ecosystem.

When the farming activity involves the raising of livestock and using natural grasses for grazing, it is critical to understand the lifecycle and characteristics of local grasses so that the correct grazing methods (rotational grazing in fenced camps) and stocking levels can be applied. In order to ensure that biodiversity is maintained and improved over time, there should be a balance between pioneer, intermediate and climax grass species. For most commercial farmers, the aim is to improve climax grass species, as these are usually the most palatable for grazing animals. However, for a farmer concerned with biodiversity, the ideal is to strive towards a balance in species.

3.3 The consequences of not maintaining and increasing natural resources

When we farm without taking the conservation of natural resources into account we undermine the land’s ability to sustain farming activities for future generations. If the ecosystem becomes weakened through, for example, overgrazing, soil erosion can take place and this, in turn, leads to a lower productivity. Lower productivity on a farm leads to lower profits.

Every living organism in ecology has a specific function; it interacts with a number of other organisms and it is part of a complex food web. If one or more of the species is removed from that web the delicate balance can be upset and the consequences of which cannot always be accurately predicted. If predator species are removed, the organisms upon which they preyed would increase in number and the incidence of a higher number of these organisms could have a damaging impact on farming activities.

If the numbers of a particular species declines then the genetic diversity within that species could be undermined and that could lead to weakness becoming more prevalent in the population.

We do now know what the impact is going to be of the organisms that have become extinct in both the plant and animal kingdoms. We do know that it is likely that many more plants will be identified as sources of useful properties, such as medicines. If we undermine the genetic and species diversity of our natural areas we increase the chances that we may never be able to utilise these resources if they become lost to us.
Please complete Activity 1 in your learner workbook.

**How am I doing?**

<table>
<thead>
<tr>
<th>Concept (SO 3)</th>
<th>I understand this concept</th>
<th>Questions that I still would like to ask</th>
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<tr>
<td>The importance of maintaining and increasing natural resources.</td>
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<tr>
<td>Natural resources.</td>
<td></td>
<td></td>
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<tr>
<td>Consequences of not maintaining natural resources.</td>
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**My Notes ...**

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Session 4

Control invasive alien plant species and noxious weeds

After completing this session, you should be able to:
SO 4: Control invasive alien plant species and noxious weeds.

In this session we explore the following concepts:
- Alien plant species are correctly identified.
- Methods of clearing
- Sorting and disposing of cleared plant material

4.1 Identify alien plant species

In Session One you identified alien and invasive plants that grow in your area. Now we consider ways to control these plants.

Controlling Weeds

- Chemical Control
  - Apply specific Chemicals with action on specific weeds
  - Apply Chemicals to soil to prevent the sprouting of weeds
- Biological Control
  - Introduce natural enemies which will eat the plants
  - Introduce barring methods to prevent that weeds come up, e.g. planting cover crops to suppress weeds or mulching to prevent weeds from sprouting
- Manual Control
  - Pulling up or digging out weeds with handtools or machinery
4.2 Methods to control alien plant species

Methods to control invasive alien plants include:

- Mechanical methods - felling, removing or burning invading alien plants.
- Chemical methods - using environmentally safe herbicides.
- Biological control - using species-specific insects and diseases from the alien plant’s country of origin. To date 76 bio control agents have been released in South Africa against 40 weed species.
- Integrated control - combinations of the above three approaches. Often an integrated approach is required in order to prevent enormous impacts.

Let’s look at an example of such a practice

<table>
<thead>
<tr>
<th>Plant name (Author)</th>
<th>Diagnostics</th>
<th>Plant photo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acacia mearnsii (De Wild.)</td>
<td>Unarmed, evergreen tree 5?10(?15) m high; branchlets shallowly ridged; all parts finely hairy; growth tips golden-hairy. Leaves: dark olive-green, finely hairy, bipinnate; leaflets short (1.5 to 4.0 mm) and crowded; raised glands occur at and between the junctions of pinnae pairs. Flowers: pale yellow or cream, globular flower heads in large, fragrant sprays, August-September. Fruits: dark brown pods, finely hairy, usually markedly constricted.</td>
<td><img src="image" alt="Plant Photo" /></td>
</tr>
</tbody>
</table>
**Acacia mearnsii (De Wild.)**

**Family:** Fabaceae  
**Type plant:** Trees

**Popular Names:**  
Black wattle (English)  
Swartwattel (Afrikaans)  
Wattel, swart- (Afrikaans)  
Wattle, black (English)

**Synonyms:**
<table>
<thead>
<tr>
<th>Invasive status</th>
<th>Category 2: Invasive Alien Species Regulated by Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecological impact / threat</td>
<td>The genus <em>Acacia</em> comprises some 1500 species, and close to 1000 of these are indigenous to Australia, where they are commonly known as wattles. Many other Acacia species naturally occur in Africa, spreading to other parts of the continent where they are considered serious invaders. Because of the vast number of acacia species, only a few are highlighted below, with a focus on some of the more serious Australian invasive species introduced to South Africa, highlighting a variety of negative consequences deriving from these introductions.</td>
</tr>
<tr>
<td>Habitat invaded</td>
<td>Alien acacias generally have higher water requirements than the indigenous vegetation they replace, so infestations in catchment areas and along watercourses reduce runoff and hence river flow. This not only has detrimental impacts on riverine and wetland ecosystems, but ultimately translates to less water in dams for agricultural, industrial and domestic use.</td>
</tr>
<tr>
<td></td>
<td>Impenetrable thickets along watercourses block access of people and livestock to water, and obstruct the flow of rivers – particularly during floods, when fallen trees create logjams and blockages that cause further flood damage. Dense stands of acacias also reduce the productive potential of land by taking over agriculturally valuable areas, and heighten the risk and intensity of fire by increasing the fuel load. Very hot fires destroy the seeds of indigenous species, compromising post-fire regeneration.</td>
</tr>
<tr>
<td></td>
<td>Alien acacias also cause a loss of biodiversity by out competing indigenous species and disrupting natural ecosystem functioning. The Cape Floristic Region – world renowned for its rich biodiversity – is particularly vulnerable in this regard. The indigenous fynbos plants are adapted to nutrient-poor sandy soils, but acacias are nitrogen-fixing plants that increase nitrate levels in the soil. Many indigenous species cannot survive in the enriched soils surrounding acacias, allowing the alien invaders to form bland monocultures. These spoil the Cape Floristic Region’s natural beauty and detract from the tourism experience. Furthermore, the absence of ground-cover in acacia thickets may result in increased soil erosion.</td>
</tr>
<tr>
<td></td>
<td>Australian acacias that have become invasive in the Cape Floral Kingdom include rooikrans (<em>A. cyclops</em>), Port Jackson (<em>A. saligna</em>), long-leaved wattle (<em>A. longifolia</em>), black wattle (<em>A. mearnsii</em>) and blackwood (<em>A. melanoxylon</em>), as well as golden wattle (<em>A. pycnantha</em>), which is Australia’s national floral emblem. Ironically, an African acacia, <em>A. nilotica</em>, is one of Australia’s worst invasive weeds!</td>
</tr>
</tbody>
</table>
Understand how sustainable farming systems conserve natural resources

**Human uses**

Shelter, tanbark, woodchips, shade; provides firewood and construction poles.

**Animal uses**

None

**Biological control**

The seed-feeding weevil *Melanterius maculatus* is available for the biological control of black wattle, while two gall-forming midges are being considered as supplementary biocontrol agents. In addition, an indigenous fungus has been registered as a mycoherbicide. Applied as a cut-stump treatment, it kills the stumps and any regrowth within a year.

**Chemical and Physical control**

Black wattle is a vigorous resprouter, so felled trees will lead to regrowth unless the stump is treated or the entire plant is removed. Large trees are usually felled as close to the ground as possible, and the stump treated with a registered herbicide. Seedlings and saplings can be pulled out by hand when the soil is damp, but chemical control is often preferable if growth is very dense as large-scale uprooting results in soil disturbance, which promotes the germination of wattle seeds. However, it is important that selective herbicides are used where grasses are present, and that diesel-based herbicides are not used along watercourses, so as to avoid contaminating the water.

### 4.3 Sorting, disposing of and re-using cleared plant material

The cleared plant material can be used in different ways; as mulch and/or compost:

Mulch is a layer of organic material covering the soil roughly 5 – 10 cm thick. Mulch moderates soil temperature and reduce the evaporation of soil water. The organic material also breaks down in the soil, contributing to the humus content, and therefore the water-retention ability of soil. A thick mulch layer also suppresses weed growth and prevents soil erosion.

Composting is the piling up of organic materials in a certain sequence and ratio so that the heap becomes hot within a few hours and over a period of weeks the organic material decomposes.
The ingredients for a compost heap are as follows:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Examples</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>A layer of sticks – one layer only, about 10 – 12 cm thick.</td>
<td>Old, cut hedges or pruned trees.</td>
<td>A mattress-like layer on the ground that allows air to penetrate the heap.</td>
</tr>
<tr>
<td>&quot;Wet&quot; stuff – about 5 wheelbarrow loads for one heap. Each layer is about 15 cm deep.</td>
<td>Any green, leafy material, raw plant-based food scraps. The higher the water content, the better.</td>
<td>This provides the nitrogen for the compost 'fire'.</td>
</tr>
<tr>
<td>Old, well-rotted manure or old compost. A 5 cm layer between each 'wet' and 'dry' layer.</td>
<td></td>
<td>Starts the heating up process of the compost heap.</td>
</tr>
<tr>
<td>&quot;Dry&quot; stuff – about five wheelbarrow loads for one heap. Each layer is about 15 cm deep.</td>
<td>Any old leaves, dry or partially rotted plant material.</td>
<td>This provides the 'kindling' for the compost 'fire'.</td>
</tr>
<tr>
<td>Water.</td>
<td></td>
<td>Provides a moist environment – so that the heap has the consistency of a squeezed sponge.</td>
</tr>
</tbody>
</table>

Please complete Activity 7 in your learner workbook.

My Notes ...

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<td>Let's correctly identify alien plant species.</td>
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<tr>
<td>Correct methods of clearing.</td>
<td></td>
<td></td>
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<tr>
<td>Sorting, disposing or re-using cleared plant material as mulch, compost.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clarity on substances that should be taken to a proper disposal facility.</td>
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</table>
Prevent the spread of veldt fires using firebreaks and/or fireguards

In this session we explore the following concepts:

- Available material or plants are used as and where appropriate
- Vegetation that might spread fire is cleared.
- Stones are packed to form a proper barrier.

5.1 The risk of fire and what can be done to prevent it

Most regions in South Africa are situated in naturally fire-prone ecosystems. The inherent fire hazard is exacerbated by the following:

The direct losses are in terms of:

- loss of life, and disability, due to vegetation fires;
- loss of housing and possessions when thatched or wooden dwellings ignite, and
- loss of grazing, crops, livestock and subsistence natural resources.

Of equal – if not greater – importance is the “knock-on” effect of wild fires on rural economies.

A firebreak forms a boundary that is able to hinder a runaway fire. However, a firebreak cannot stop every veldt fire and it is inevitable that at some time when conditions are so severe that a fire may jump a break. A firebreak is a useful tool to stop many fires, provide a line from which to combat (by back burning) a fire and protect a property.
All landowners are required to prepare firebreaks on their side of the boundary. There are a numerous ways to build a firebreak, for example:

- Grading
- Ploughing
- Disking
- Hoeing
- Burning

It is advisable for farmers to remove protected plants from the path of a firebreak. These plants must be transplanted where possible.

### 5.2 How to prepare to burn fire breaks

#### Purpose of firebreaks

- Anyone with experience of veld fires knows that a firebreak cannot stop every veld fire.
- There will inevitably be a time when conditions are so severe that a fire will cross a break, by spotting or otherwise.
- However, experience has shown consistently and repeatedly that firebreaks are useful:
  - in stopping many fires
  - in providing a line from which to combat veld fires by counter firing or other measures
  - for protection of property generally.

Figure 5.1 A firebreak being burnt in controlled conditions
The basic principle in fighting fires is to create a gap, or firebreak, across which the fire cannot move.

Where possible, take advantage of streams, open spaces or other natural obstacles such as stones and rocks cleared from a field or orchard or a road, or sandy / rocky area.

If there is no natural break, one is prepared - usually with discs, ploughs and bulldozers. The sides are then soaked with water or chemicals to slow the combustion process.

It is always a good idea to:

- Contact the neighbour and agree to burn on mutually acceptable dates.
- Inform the Fire Protection Association or the local Fire Department on agreed upon dates
- It is best to burn firebreaks on same day as neighbours, however this may not be possible at all times.

5.3 Preparing firebreaks

- **The requirement to prepare firebreaks**
  - Landowners are required to prepare firebreaks on their side of the boundary where there is a reasonable risk of veldt fire.
  - How do we know what a reasonable risk is?
  - The courts use the "reasonable person test":
    - if a reasonable person in the position of the landowner would foresee that by not preparing a firebreak, a veldt fire could start or spread across his or her land, causing harm to someone else, and therefore would prepare one, then the landowner should also prepare one.

- **Preparing firebreaks**
  - Firebreaks can be prepared in a number of ways, for example, by grading, ploughing, disking, hoeing or burning.
  - It is only in the development of a firebreak that a landowner may damage, destroy or remove any protected plants, despite what the National Forest Act or any other law says. But the owner must transplant protected plants if possible or position the firebreak to avoid protected plants.
  - The National Environment Management Act requires biodiversity to be protected.
  - The Act sets out a procedure for burning firebreaks.
  - Neighbours can agree to reposition a firebreak on a common boundary.

- **Burning cannot go ahead if:**
  - Fire Department objects.
  - High fire danger rating.
  - Conditions not conducive.
Requirements for firebreaks

- The Act doesn’t specify requirements for firebreaks because requirements will vary from one situation to the next. For example, on the Cape Peninsula, firebreak requirements would be different from what is needed in the eastern Free State.
- Local practice and local issues must determine what the requirements are.
- The Act states that the owner must pay attention to weather, climate, terrain and vegetation in deciding on how to prepare the break.
- The break must:
  - be wide enough and long enough to have a reasonable chance of stopping the veld fire
  - not cause soil erosion
  - be reasonably free of inflammable material (s13).

When to Burn Firebreak Strips

By burning your firebreak strips under optimal burning and weather conditions, you will achieve the best results with maximum efficiency. Under optimal conditions, you can expect to burn 4 to 5 km of strip a day.

- For best results, ensure that:
  - The grass is dead and burns readily.
  - The grass is dry.

Note: Since dew on the grass inhibits burning, it is best not to begin burning before 09:30 or 10:00.

- The grass is not too long.
- If the grass is longer than 1 m, we recommend that you cut it before burning. This will reduce the risks associated with wind and the height of the flames.

Note: Do not cut the grass shorter than about 25 cm—sufficient fuel is required to burn an effective firebreak.

- The wind is minimal.

Wind increases the risk of embers flaring up in the burned strip and sparks being carried onto surrounding vegetation. Ember flare-up is most likely to occur up to 200 m. We do not recommend burning in wind with gusts of more than 3 to 5 km per hour.

Design of a Firebreak

There are no set requirements for the width or design of firebreaks but there are general guidelines, these being:

- Contact the local Fire Department or Fire Protection Association to establish what measures should be taken in your area.
- Must be wide and long enough to have a reasonable chance of stopping a veldt fire.
Must not cause soil erosion.
Be reasonably free of inflammable material
Grading, Ploughing, Disking and hoeing do not create smoke.

Please complete Activities 8 & 9 in your learner workbook.

<table>
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<tr>
<td>Available material or plants are used as and where appropriate.</td>
<td></td>
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<tr>
<td>Vegetation that might spread fire is cleared.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stones are packed to form a proper barrier.</td>
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My Notes …

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Session 6

Basic control and preventative measures

After completing this session, you should be able to:
SO 6: Apply basic control and preventative measures to enhance the soil’s capacity to hold water and prevent water run-off.

In this session we explore the following concepts:

✦ Mulching to cover soil for water and soil conservation.
✦ Water run-off from soil is prevented and its capacity to hold water is improved.
✦ The erection of gabions.
✦ Re-establish vegetation.

6.1 Mulching for soil conservation

This has been covered in Section 4.1. To recap, mulching is important because it:

✦ Prohibits abundant weed growth
✦ Prevents soils from drying out too quickly
✦ Surface evaporation is prevented when soil is covered with a 5cm layer of mulch.
✦ At the same time the mulching material is rotting and being incorporated into the soil by worms and other soil inhabitants to improve soil fertility.
✦ A layer of mulch will prevent water losses through evaporation and surface runoff.
✦ The shading of the mulch will prevent the soil from becoming too hot in summer and too cold during winter months.

Please complete Activity 10 in your learner workbook.

My Notes ...

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6.2 Donga rehabilitation

Sausage gabions can be used for irrigation channels on fairly steep slopes where reduction of water velocity is required and rapid sedimentation and vegetation growth is essential.

6.3 Re-enforced soil walls

For walls in fill situations above 4m in height, either wire mesh, grid or steel bars can be attached to the gabion baskets and extended into the fill behind this will assist in reinforcing the soil fill behind the gabion wall. In areas where rock is limited and rapid construction progress is required this application becomes very economical and well suited.
6.4 Terracing

To allow for adequate drainage and embankment support, and at the same time allowing for neat slopes and vegetation.

6.5 Erecting gabions

Soil erosion is an ever-present problem and gabions have proved to be a lasting civil engineering solution around the world. The earliest use of gabion type structures was for bank protection along the River Nile, approximately 7000 years ago. Since then gabion baskets have evolved from woven reed baskets, which were often used for military applications, to engineered containers made from wire mesh.

Gabions are rectangular cages made of hexagonal double-twist wire mesh filled with appropriately sized rock or quarry stone. The wire used is a mild tensile steel wire, class A galvanized to SABS 675 of 1993.

The gabions are sub-divided into cells by inserting diaphragms which are mesh panels with the same characteristics as the external sides, spaced 1m from each other to give the structure strength and facilitate it’s speedy construction.

The galvanized wire, before being woven, can be coated with a special PVC (polyvinyl chloride) coating 0.5mm thick. This additional coating gives full protection from corrosion in marine or heavily polluted environments.

Figure 6.1: A water channel that has been constructed in the form of gabion walls
Understand how sustainable farming systems conserve natural resources

Primary Agriculture NQF Level 1 Unit Standard No: 116169

Figure 6.2: Cubes of wire mesh that will be filled with rocks to form a gabion

6.6 The advantages of building gabions

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLEXIBLE</td>
<td>Superior to rigid type structures. The hexagonal mesh construction permits natural adjustment to varying conditions of earth settlement without causing fracture or collapse of the structure.</td>
</tr>
<tr>
<td>DURABLE</td>
<td>Gaps between the stones silt up naturally as time passes. Silting supports the growth of grass and plants which serve as a bonding agent for the stone.</td>
</tr>
<tr>
<td>PERMEABLE</td>
<td>A Gabion structure allows water to pass through, water pressure cannot build up behind it and the structure is continuously drained.</td>
</tr>
<tr>
<td>STRONG</td>
<td>The flexibility of the Gabion structure provides the inherent strength to withstand and dissipate pressures exerted by water and earth masses.</td>
</tr>
<tr>
<td>ECONOMICAL</td>
<td>Filling materials are usually found on or near the site. No structural maintenance is needed and foundation work is usually unnecessary.</td>
</tr>
<tr>
<td>NATURAL APPEARANCE</td>
<td>Natural stone makes the structure aesthetically pleasing especially when subsequent vegetation growth takes place.</td>
</tr>
<tr>
<td>SIMPLE</td>
<td>Unskilled labour can be used for quick assembly.</td>
</tr>
<tr>
<td>MAINTENANCE</td>
<td>Gabion structures are easily maintained using additional mesh or grouting.</td>
</tr>
<tr>
<td>FUNCTIONABLE</td>
<td>Once the structure is built there is no waiting period – it functions immediately.</td>
</tr>
<tr>
<td>EXTENDABLE</td>
<td>Extensions are simple. Additional units are simply attached to the existing ones.</td>
</tr>
</tbody>
</table>
Re-establishing vegetation is an important part of soil conservation. Bare soil that has been eroded is totally vulnerable to heavy rains and must be covered as soon as possible.

The first step is to identify suitable, appropriate and available plant materials.

- If the soil is part of grassland, then the soil can be imprinted with small depressions in which grass seeds and water will collect.
- If the soil is part of a water course, or seasonal/temporary wetland, then it is best to establish a good boundary of plants on contour that will hold the soil and prevent further run-off. Tyres or other suitable objects can be placed on contour to assist in the establishment of appropriate plants.
- If the area is to be planted at a later stage it might be appropriate to plant a green manure, such as Lucerne, which will later be incorporated into the soil.

<table>
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<tr>
<td>Mulching to cover soil for water and soil conservation is used.</td>
<td></td>
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<tr>
<td>The soil’s run-off and capacity to hold water are prevented and improved.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gabions are correctly erected.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetation is re-established.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Bibliography

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1. Encyclopaedia Brittanica – South African Version
2. People Farming Workbook – Environmental and Development Agency Trust

World Wide Web:
8. http://www.gisp.org/about/members.asp#SANBI
9. www.CABI.org
10. www.dwaf.org.za

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**REGISTERED UNIT STANDARD:**

**Understand how sustainable farming systems conserve natural resources**

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<td>Field 01 - Agriculture and Nature Conservation</td>
<td>Primary Agriculture</td>
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<td>2007-10-13</td>
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**PURPOSE OF THE UNIT STANDARD**

Learners achieving this unit standard will be able to explain the importance of maintaining and increasing biodiversity, and the role of natural resource management in sustainable agricultural practices.

Competent learners will have a general idea of the most important agricultural and conservation regulations, thus strengthening sustainable agricultural practices and benefiting the environment.

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

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

**LEARNING ASSUMED TO BE IN PLACE AND RECOGNITION OF PRIOR LEARNING**

No learning is assumed to be in place.
UNIT STANDARD RANGE

Whilst range statements have been defined generically to include as wide a set of alternatives as possible, all range statements should be interpreted within the specific context of application.

Range statements are neither comprehensive nor necessarily appropriate to all contexts. Alternatives must however be comparable in scope and complexity. These are only as a general guide to scope and complexity of what is required.

UNIT STANDARD OUTCOME HEADER

N/A

Specific Outcomes and Assessment Criteria:

SPECIFIC OUTCOME 1

Demonstrate an understanding of the impact of farming operations and practices on the environment.

ASSESSMENT CRITERIA

ASSESSMENT CRITERION 1

The farmer’s responsibilities of soil-, water- and animal-care are explained.

ASSESSMENT CRITERION 2

Elements of farming operations affecting the environment are identified and described.

ASSESSMENT CRITERION RANGE

Effects on the environment include soil erosion, water pollution and wastage, invasive plants, fire, flood and population encroachment, endangered plants and endangered fauna.

ASSESSMENT CRITERION 3

Invasive and endangered fauna and flora species are listed and identified.

ASSESSMENT CRITERION RANGE

Fauna and flora species of the farm or direct environment.

ASSESSMENT CRITERION 4

Examples of environmentally friendly agricultural practices are explained.

ASSESSMENT CRITERION RANGE

Soil and water conservation.

SPECIFIC OUTCOME 2

Identify farm and domestically generated waste and pollutants and apply environmentally friendly methods of disposal and/or re-use.

ASSESSMENT CRITERIA
ASSESSMENT CRITERION 1
Farm generated waste and pollutants are identified and their effects are explained.

ASSESSMENT CRITERION RANGE
Domestic waste products include but are not limited to body fluids and solids, wash water and household waste. Farm generated waste and pollutants include fertilisers, chemicals, fuels and lubricants, packaging and product waste.

ASSESSMENT CRITERION 2
Pollution prevention measures are identified and their effects on the environment are explained.

ASSESSMENT CRITERION RANGE
Fertiliser and chemical management, recycling, machinery maintenance and basic rubbish dump management.

ASSESSMENT CRITERION 3
Correct methods of disposal are applied to the waste product and pollutant.

ASSESSMENT CRITERION RANGE
Clarity on substances that should be taken to a proper disposal facility.

SPECIFIC OUTCOME 3
Apply practices to maintain and increase biodiversity.

OUTCOME RANGE
Natural resources include water, soil, fauna, flora and energy.

ASSESSMENT CRITERIA

ASSESSMENT CRITERION 1
The importance of maintaining and increasing natural resources are explained.

ASSESSMENT CRITERION RANGE
Natural resources include energy (wood, sun and electricity), water (rain, surface and groundwater), soil, fauna, flora (trees, vegetation and medicinal plants) and fire management practices.

ASSESSMENT CRITERION 2
Consequences of not maintaining natural resources are explained.

ASSESSMENT CRITERION RANGE
Lack of ecosystem stability resulting from decrease in species diversity; disease, genetic diversity loss, lost unknown pharmaceutical and breeding opportunities from plants and animals with unknown properties.

SPECIFIC OUTCOME 4
Control invasive alien plant species and noxious weeds.

**OUTCOME RANGE**

As outlined by the local Department of Agriculture (Agricultural Research Council guidelines).

**ASSESSMENT CRITERIA**

**ASSESSMENT CRITERION 1**

Alien plant species are correctly identified.

**ASSESSMENT CRITERION 2**

Methods of clearing are correctly applied (first clear least invaded areas, follow up and maintain; then expand into intensively infested areas).

**ASSESSMENT CRITERION 3**

Cleared plant material is sorted and disposed of or re-used as mulch, compost, etc. as appropriate.

**SPECIFIC OUTCOME 5**

Prevent the spread of veld fires using on farm firebreaks and/or fireguards.

**OUTCOME RANGE**

Fireguards include fire resistant plants, water and stones.

**ASSESSMENT CRITERIA**

**ASSESSMENT CRITERION 1**

Available material or plants are used as and where appropriate.

**ASSESSMENT CRITERION 2**

Vegetation that might spread fire is cleared.

**ASSESSMENT CRITERION 3**

Stones are packed to form a proper barrier.

**SPECIFIC OUTCOME 6**

Apply basic control and preventative measures to enhance the soil`s capacity to hold water and prevent water run-off.

**OUTCOME RANGE**

Control measures include but are not limited to gabions, mulch, plant and vegetation material, etc.

**ASSESSMENT CRITERIA**

**ASSESSMENT CRITERION 1**

Mulching to cover soil for water and soil conservation is used.
ASSESSMENT CRITERION 2
The soil’s run-off and capacity to hold water are prevented and improved.

ASSESSMENT CRITERION 3
Gabions are correctly erected.

ASSESSMENT CRITERION 4
Vegetation is re-established.

UNIT STANDARD ACCREDITATION AND MODERATION OPTIONS
The assessment of qualifying learners against this standard should meet the requirements of established assessment principles.

It will be necessary to develop assessment activities and tools, which are appropriate to the contexts in which the qualifying learners are working. These activities and tools may include an appropriate combination of self-assessment and peer assessment, formative and summative assessment, portfolios and observations etc.

The assessment should ensure that all the specific outcomes; critical cross-field outcomes and essential embedded knowledge are assessed.

The specific outcomes must be assessed through observation of performance. Supporting evidence should be used to prove competence of specific outcomes only when they are not clearly seen in the actual performance.

Essential embedded knowledge must be assessed in its own right, through oral or written evidence and cannot be assessed only by being observed.

The specific outcomes and essential embedded knowledge must be assessed in relation to each other. If a qualifying learner is able to explain the essential embedded knowledge but is unable to perform the specific outcomes, they should not be assessed as competent. Similarly, if a qualifying learner is able to perform the specific outcomes but is unable to explain or justify their performance in terms of the essential embedded knowledge, then they should not be assessed as competent.

Evidence of the specified critical cross-field outcomes should be found both in performance and in the essential embedded knowledge.

Performance of specific outcomes must actively affirm target groups of qualifying learners, not unfairly discriminate against them. Qualifying learners should be able to justify their performance in terms of these values.

Anyone assessing a learner against this unit standard must be registered as an assessor with the relevant ETQA.

Any institution offering learning that will enable achievement of this unit standard or assessing this unit standard must be accredited as a provider with the relevant ETQA.

Moderation of assessment will be overseen by the relevant ETQA according to the moderation guidelines in the relevant qualification and the agreed ETQA procedures.

UNIT STANDARD ESSENTIAL EMBEDDED KNOWLEDGE
The person is able to demonstrate a basic knowledge of:
Basic principles of natural resources management.
Components of the water cycle.
Components of ecosystems.
Components of an energy cycle.
Basic principles of sustainability.
Local veld types and their carrying capacities.
Classification of fauna and flora relevant to the direct environment.
Alien species relevant to the direct environment.
Basic environmental patterns and processes.
Local weather and climate, and seasonal conditions of the area.
Basic local ecosystems.
Importance of biodiversity in local farming systems.
Sources of water.
Sources of energy (renewable and non renewable).
Types of pollution.
Basic fire fighting rules.
Definitions.
Terminology.

UNIT STANDARD DEVELOPMENTAL OUTCOME
N/A

UNIT STANDARD LINKAGES
N/A

Critical Cross-field Outcomes (CCFO):

UNIT STANDARD CCFO IDENTIFYING
Problem solving relates to specific outcomes:
  Demonstrate an understanding of the impact of farming operations and practices on the environment.
  Identify farm and domestically generated waste and pollutants and apply environmentally friendly methods of disposal and/or re-use.
  Apply practices to maintain and increase biodiversity.
  Understand how to control invasive alien plant species and noxious weeds.
  Prevent the spread of veld fires using on farm firebreaks and/or fireguards.

UNIT STANDARD CCFO WORKING
Teamwork relates to specific outcomes:
  Demonstrate an understanding of the impact of farming operations and practices on the environment.
  Identify farm and domestically generated waste and pollutants and apply environmentally friendly methods of disposal and/or re-use.
  Apply practices to maintain and increase biodiversity.
  Understand how to control invasive alien plant species and noxious weeds.
  Prevent the spread of veld fires using on farm firebreaks and/or fireguards.

UNIT STANDARD CCFO ORGANIZING
Self-organisation and management relates to specific outcomes:
  Demonstrate an understanding of the impact of farming operations and practices on the environment.
Identify farm and domestically generated waste and pollutants and apply environmentally friendly methods of disposal and/or re-use.

Apply practices to maintain and increase biodiversity.

Understand how to control invasive alien plant species and noxious weeds.

Prevent the spread of veld fires using on farm firebreaks and/or fireguards.

UNIT STANDARD CCFO COLLECTING

Information evaluation relates to specific outcomes:

Demonstrate an understanding of the impact of farming operations and practices on the environment.

Identify farm and domestically generated waste and pollutants and apply environmentally friendly methods of disposal and/or re-use.

Apply practices to maintain and increase biodiversity.

Understand how to control invasive alien plant species and noxious weeds.

Prevent the spread of veld fires using on farm firebreaks and/or fireguards.

UNIT STANDARD CCFO COMMUNICATING

Communication relates to specific outcomes:

Demonstrate an understanding of the impact of farming operations and practices on the environment.

Identify farm and domestically generated waste and pollutants and apply environmentally friendly methods of disposal and/or re-use.

UNIT STANDARD CCFO SCIENCE

Use science and technology relates to specific outcomes:

Demonstrate an understanding of the impact of farming operations and practices on the environment.

Identify farm and domestically generated waste and pollutants and apply environmentally friendly methods of disposal and/or re-use.

Apply practices to maintain and increase biodiversity.

Understand how to control invasive alien plant species and noxious weeds.

Prevent the spread of veld fires using on farm firebreaks and/or fireguards.

UNIT STANDARD CCFO DEMONSTRATING

Inter-relatedness of systems relates to specific outcomes:

Demonstrate an understanding of the impact of farming operations and practices on the environment.

Identify farm and domestically generated waste and pollutants and apply environmentally friendly methods of disposal and/or re-use.

Apply practices to maintain and increase biodiversity.

Understand how to control invasive alien plant species and noxious weeds.

Prevent the spread of veld fires using on farm firebreaks and/or fireguards.

UNIT STANDARD ASSESSOR CRITERIA

N/A

UNIT STANDARD NOTES

N/A