

Reading 1: What Is a Drought?



Australia is the driest inhabited continent in the world. Rainfall is not spread evenly across the country. Some places receive regular rain, while large parts of inland Australia receive very little.

A **drought** is a long period when a place does not receive enough rain. The shortage of rain must continue long enough to cause problems for people, plants, animals or water supplies.

A few dry days are not a drought. Some parts of Australia regularly experience dry weather. A drought occurs when a place is much drier than usual for several months or years.

The Bureau of Meteorology compares recent rainfall with rainfall records from previous years. The **Bureau of Meteorology** is the Australian government organisation that observes and reports on weather, climate and water.

A **rainfall deficiency** occurs when a place receives much less rain than it normally receives. The Bureau arranges rainfall records into ten equal groups called **deciles**. Rainfall in the **lowest decile** belongs to the driest 10% of recorded years for that place.

Different types of drought can occur.

Type	Student-friendly definition
Meteorological drought	A long period of below-average rainfall
Agricultural drought	A shortage of water in the soil for crops and farm animals
Hydrological drought	Unusually low water levels in rivers, lakes, dams and underground water
Ecological drought	A shortage of water that damages plants, animals and ecosystems
Socio-economic drought	A water shortage that affects people, jobs, businesses and communities

An **ecosystem** is a community of living things and the environment in which they interact.

These types of drought are connected. Low rainfall can dry the soil. Rivers and dams may then fall, affecting farms, towns, businesses and ecosystems.

Key terms

- **Drought:** a long period when there is not enough water.
- **Rainfall:** water that falls from clouds as rain.
- **Rainfall deficiency:** a period when rainfall is much lower than usual.
- **Below average:** lower than the amount normally recorded.
- **Decile:** one of ten equal groups used to compare data.
- **Water shortage:** a situation in which there is not enough water to meet people's or the environment's needs.

Reading 2: Why Droughts Occur



Droughts are caused by a combination of weather, climate and geographical conditions.

Weather describes short-term atmospheric conditions, such as today's temperature, rain and wind. **Climate** describes the usual pattern of weather in a place over a long period.

Variable rainfall

Australian rainfall is **variable**, which means it can change greatly between different places and years. A region may experience several wet years followed by a number of dry years.

Much of inland Australia is far from the ocean. These inland areas regularly experience **high-pressure systems**. A high-pressure system is an area of sinking air that often produces clear skies and dry weather.

El Niño

El Niño is a change in ocean temperatures and winds across the tropical Pacific Ocean. During El Niño, eastern Australia often receives less rain than usual. El Niño can increase the chance of drought, heatwaves and dangerous bushfire weather.

Not every El Niño causes drought in every part of Australia. Other weather and climate conditions also influence rainfall.

La Niña is the opposite phase. La Niña often brings increased rainfall to eastern and northern Australia. It can help end a drought, but it may also produce floods.

Indian Ocean Dipole

The **Indian Ocean Dipole**, or **IOD**, is a pattern of changing water temperatures in the Indian Ocean. During a **positive IOD**, less moisture may reach southern and central Australia. This can reduce winter and spring rainfall.

High temperatures

High temperatures can make drought more severe by increasing **evaporation**. Evaporation occurs when liquid water heats up and changes into water vapour.

During hot weather, water is lost from soil, rivers, dams and plants more quickly. The land may therefore become very dry even when some rain has fallen.

Key terms

- **Weather:** short-term conditions in the atmosphere.
- **Climate:** the usual pattern of weather over a long period.
- **Variable:** likely to change or be different.
- **High-pressure system:** sinking air that often causes clear and dry weather.
- **El Niño:** a Pacific Ocean climate pattern that can bring drier conditions to Australia.
- **La Niña:** a Pacific Ocean climate pattern that often brings wetter conditions.
- **Indian Ocean Dipole:** a pattern of ocean temperatures that influences Australian rainfall.
- **Evaporation:** the process through which liquid water becomes water vapour.
- **Water vapour:** water in its gas form.

Reading 3: Where Droughts Occur



Drought can affect every Australian state and territory. However, it does not usually affect every place at the same time or with the same level of severity.

The **severity** of a drought refers to how serious it is. A severe drought has greater water shortages and stronger effects than a less serious drought.

Drought often affects:

- Inland New South Wales
- Inland Queensland
- Northern and western Victoria
- South Australia
- South-western Western Australia
- Parts of the Northern Territory
- The Murray–Darling Basin

Tasmania can also experience drought, especially in its drier eastern and central areas.

Comparing rainfall fairly

Drought is measured against the rainfall that is normally expected in each place.

For example, imagine that an inland town usually receives 300 millimetres of rain each year. If it receives 280 millimetres, the year may be slightly drier than normal.

A coastal town might usually receive 1,200 millimetres. If it receives only 600 millimetres, it may be experiencing a serious rainfall deficiency, even though it still received more rain than the inland town.

This is why geographers compare a place's rainfall with its own long-term average.

A **long-term average** is a typical amount calculated using records collected over many years.

The Murray–Darling Basin

A **basin** is an area of land where water drains into connected rivers. The Murray–Darling Basin covers more than one million square kilometres across Queensland, New South Wales, Victoria, South Australia and the Australian Capital Territory.

The Basin contains farms, towns, rivers, wetlands and many First Nations Countries. It produces a large amount of Australia's food.

A **wetland** is an area of land that is covered or soaked with water for all or part of the year.

When rain falls, some water flows across the ground into rivers and dams. This water is called **run-off**. During drought, less rainfall creates less run-off. Rivers, dams and water supplies may then decline.

Key terms

- **Distribution:** the way something is spread across different places.
- **Severity:** how serious or damaging something is.
- **Inland:** an area located away from the coast.
- **Long-term average:** the typical amount calculated from many years of data.
- **Basin:** land drained by a river and its smaller rivers.
- **Wetland:** land covered or soaked with water.
- **Run-off:** water that flows across the ground into rivers, lakes or dams.

Reading 4: Major Australian Droughts



Drought has affected Australia many times. A drought that continues for a long time is described as **prolonged**.

Drought	Approximate period	Main information
Federation Drought	1895–1903	Affected much of Australia and caused major farming losses
World War II Drought	1937–1945	Affected farming and water supplies across eastern and southern Australia
1982–1983 Drought	1982–1983	Connected to El Niño, extreme heat and dangerous bushfire weather
Millennium Drought	Approximately 1997–2009	Caused serious water shortages across south-eastern Australia
Eastern Australian Drought	2017–2019	Caused extremely dry conditions across NSW, Queensland and other regions

The Millennium Drought

The Millennium Drought affected south-eastern Australia for more than a decade. Rainfall during the cooler months was repeatedly below average.

River flows and dam levels declined. A **river flow** is the amount of water moving through a river. A **dam** is a barrier used to collect and store water.

Cities introduced **water restrictions**, which are rules that limit how water may be used. Farmers received less water, crops failed and there was less pasture for livestock.

A **pasture** is an area of grass or other plants eaten by farm animals. **Livestock** are animals raised on farms, such as cattle and sheep.

Heavy rainfall during 2010 and 2011 helped end the drought, but it also caused floods in some areas.

The 2017–2019 drought

A serious drought developed across eastern Australia between 2017 and 2019. NSW and southern Queensland were particularly affected.

In 2019, Australia received approximately **277.6 millimetres of rainfall**. This was about **40% below** the 1961–1990 average. It made 2019 Australia's driest year since national rainfall records began in 1900.

Australia's average temperature in 2019 was also approximately **1.52°C above** the long-term average. The combination of heat and low rainfall dried the landscape and contributed to dangerous bushfire conditions.

Key terms

- **Prolonged:** continuing for a long time.
- **River flow:** the amount of water moving through a river.
- **Dam:** a structure used to collect and store water.
- **Water restriction:** a rule that limits water use.
- **Pasture:** plants grown or used as food for farm animals.
- **Livestock:** animals raised on farms.
- **Historical record:** information collected and stored over many years.

Reading 5: Environmental Effects of Drought



Drought can damage natural environments by reducing the water available to plants, animals, soil, rivers and wetlands.

Rivers and wetlands

During drought, rivers may become shallow or stop flowing in some places. Wetlands and waterholes may shrink or dry out.

Water quality can also decline. **Water quality** describes how clean and healthy water is. When water becomes warmer and shallower, it may contain less oxygen. Fish and other aquatic animals can become sick or die.

An **aquatic animal** is an animal that lives in water.

Plants and animals

Plants need water to grow, produce flowers and create seeds. During drought, plants may grow slowly or die.

Animals may lose their food, water and shelter. The natural home of a plant or animal is called its **habitat**. Some animals move into towns or farms to search for water.

Biodiversity means the variety of living things in an environment. Severe drought can reduce biodiversity by damaging habitats and causing plants and animals to die.

Soil

Plants protect soil by holding it together with their roots. When plants die, dry soil can be carried away by wind or water. This process is called **erosion**.

The upper layer of soil is called **topsoil**. Topsoil contains nutrients that plants need. Losing topsoil can make it more difficult to grow crops and native vegetation.

Bushfire risk

Drought does not directly start bushfires. However, it dries grass, leaves, shrubs and trees. Dry plant material is known as **fuel** because it can burn.

If drought is combined with heat, low humidity and strong winds, bushfires can start more easily and spread more rapidly.

Humidity is the amount of water vapour in the air.

Key terms

- **Environment:** the natural and human surroundings of a place.
- **Water quality:** how clean and healthy water is.
- **Aquatic:** living or growing in water.
- **Habitat:** the natural home of a plant or animal.
- **Biodiversity:** the variety of living things.
- **Erosion:** the movement of soil or rock by wind or water.
- **Topsoil:** the upper and most fertile layer of soil.
- **Fuel:** material that can burn.
- **Humidity:** the amount of water vapour in the air.

Reading 6: Effects on Farms and Communities



Farming is particularly vulnerable to drought because crops and animals require water.

To be **vulnerable** means to be at risk of being harmed.

Crops

Crops need water at different stages of their growth. A **crop** is a plant grown by farmers for food or other products.

A lack of soil moisture can prevent seeds from growing. It can also reduce the amount of food produced. The amount of a crop harvested is called its **crop yield**.

Farmers may plant fewer crops or decide not to plant during severe drought.

Farm animals

Drought reduces the growth of pasture. Farmers may need to purchase hay or grain to feed livestock.

If animal feed and water become too expensive, farmers may sell some livestock earlier than planned. This can reduce the farm's future income.

Rural communities

A **rural community** is a community in the countryside, away from major cities.

Drought can reduce the amount of money farmers earn. At the same time, farmers may need to spend more money on water, animal feed, electricity and transport.

The effects can spread through rural towns. Local shops, mechanics, transport companies and other businesses may have fewer customers. Some families may move away to find work.

Drought can also create worry, stress and financial pressure. Community organisations may provide food, financial advice, counselling and social support.

Unequal impacts

Drought does not affect everyone equally. A farm with water storage, savings and efficient irrigation may be better prepared.

Irrigation is the controlled supply of water to crops or soil. Farmers with fewer resources may experience greater difficulties.

Key terms

- **Vulnerable:** at risk of being harmed.
- **Crop:** a plant grown for food or another useful product.
- **Soil moisture:** water held within soil.
- **Crop yield:** the amount of a crop that is harvested.
- **Rural community:** a community located outside a major city.
- **Income:** money earned by a person or business.
- **Irrigation:** supplying water to crops or soil.
- **Financial pressure:** difficulty caused by not having enough money.

Reading 7: Effects on Towns and Cities

Towns and cities also need reliable water supplies.

Urban areas may receive water from rivers, dams, groundwater, desalination plants and recycled water.

An **urban area** is a built-up place such as a city or large town. **Groundwater** is water stored beneath Earth's surface in soil and rock.

During drought, water levels in dams and rivers may decline. Governments may introduce water restrictions to reduce non-essential water use.

Non-essential water use includes activities that can be reduced or delayed, such as watering lawns or washing cars. Essential water is needed for drinking, preparing food, hygiene, hospitals and firefighting.

During the Millennium Drought, Australian cities introduced water-saving programs and built new water infrastructure.

Infrastructure refers to the structures and systems a community needs, such as dams, pipes, roads and treatment plants.

Desalination

A **desalination plant** removes salt from seawater to produce fresh water. It can provide water when rainfall is low.

However, desalination plants are expensive to build and operate. They also require large amounts of energy.

Recycled water

Recycled water is wastewater that has been cleaned and treated so that it can be used again. Depending on how it is treated, it may be used for parks, farms, gardens or industries.

Recycling water reduces demand on drinking-water supplies.

Key terms

- **Urban area:** a built-up place such as a city or town.
- **Groundwater:** water stored beneath Earth's surface.
- **Essential:** completely necessary.
- **Non-essential:** not completely necessary.
- **Infrastructure:** structures and systems needed by a community.

- **Desalination:** removing salt from seawater.
- **Recycled water:** treated wastewater that can be used again.
- **Wastewater:** water that has already been used.

Reading 8: First Nations Knowledge

Aboriginal and Torres Strait Islander Peoples have carefully observed and managed Australia's environments for tens of thousands of years.

First Nations knowledge is connected to **Country**. Country includes land, water, skies, plants, animals, people, culture and spiritual relationships.

Different Aboriginal and Torres Strait Islander Nations have their own knowledge and practices. First Nations knowledge should not be described as if it is identical across Australia.

Seasonal calendars

A **seasonal calendar** records environmental changes during different parts of the year. Some First Nations seasonal calendars contain more than the four European seasons.

They may include information about:

- Changes in weather
- Flowering plants
- Animal behaviour
- Available foods
- Water levels
- Soil conditions
- Suitable times for caring for Country

This knowledge can help people recognise environmental change and prepare for dry conditions.

Respecting cultural knowledge

Some cultural knowledge can be shared publicly, while other knowledge is restricted. **Restricted knowledge** is information that may only be shared with particular people or with permission.

Traditional Custodians must be consulted before their knowledge is used.

Consultation means respectfully seeking information, advice and permission from the appropriate people.

Key terms

- **First Nations Peoples:** Aboriginal and Torres Strait Islander Peoples.

- **Country:** the interconnected land, water, skies, living things, people and culture of a place.
- **Traditional Custodians:** First Nations Peoples with continuing responsibilities for a particular Country.
- **Seasonal calendar:** a record of environmental signs and seasonal changes.
- **Cultural knowledge:** knowledge developed and protected by a cultural group.
- **Restricted knowledge:** knowledge that cannot be shared freely.
- **Consultation:** seeking advice and permission through respectful communication.

Reading 9: Managing Drought

People cannot stop drought from occurring, but they can prepare for it and reduce its effects.

Drought management means planning and taking action before, during and after drought.

Farm management

Farmers can:

- Store water and animal feed
- Plant drought-tolerant crops
- Use efficient irrigation
- Protect soil and groundcover
- Change the number of livestock
- Use weather forecasts
- Develop more than one source of income

A **drought-tolerant crop** is a crop that can survive with less water than other crops.

Groundcover consists of grasses and plants that cover and protect soil. Keeping groundcover reduces erosion.

Drip irrigation slowly delivers water near the roots of plants. It can waste less water than spraying water across a large area.

Managing urban water

Households, councils and water authorities can:

- Repair leaking taps and pipes
- Install water-efficient appliances
- Collect rainwater
- Reuse suitable water
- Recycle wastewater
- Use desalinated water
- Plant gardens suited to the local climate

Water efficiency means using less water to complete the same task.

Government and community support

Governments provide weather information, scientific research, infrastructure and financial support.

The Australian Government's **Future Drought Fund** supports projects that help farms and rural communities prepare for future droughts.

Resilience is the ability to prepare for, cope with and recover from difficult conditions.

A successful drought response should conserve water, protect environments, support people fairly and continue over a long period.

Key terms

- **Drought management:** planning and acting to reduce drought impacts.
- **Drought-tolerant:** able to survive with little water.
- **Groundcover:** plants that cover and protect soil.
- **Drip irrigation:** a system that slowly supplies water near plant roots.
- **Water efficiency:** avoiding unnecessary water use.
- **Resilience:** the ability to prepare for, cope with and recover from difficulty.
- **Sustainable:** able to continue without seriously damaging resources or environments.

Reading 10: Drought and Climate Change



Drought and climate change are connected, but they do not mean the same thing.

Climate change is a long-term change in Earth's climate. Current climate change is mainly caused by greenhouse gases released through human activities.

A **greenhouse gas** is a gas that traps heat in Earth's atmosphere. Carbon dioxide is an important greenhouse gas.

Australia experienced droughts before human-caused climate change because its rainfall is naturally variable. Therefore, it is not accurate to state that climate change is the only cause of every drought.

However, climate change can make drought conditions more severe.

Australia has warmed by approximately **1.5°C since national temperature records began in 1910**. Higher temperatures increase evaporation and cause soil and vegetation to dry more quickly.

Rainfall patterns are also changing in southern Australia:

- April-to-October rainfall in south-western Australia has declined by approximately **16% since 1970**.
- April-to-October rainfall in south-eastern Australia has declined by approximately **9% since 1994**.

April to October is often called the **cool season** in southern Australia. Many farms, rivers and water storages depend on rain falling during these months.

Scientists expect cool-season rainfall to decrease further in parts of southern Australia. Preparing for drought and managing water sustainably will therefore become increasingly important.

Key terms

- **Climate change:** a long-term change in Earth's climate.
- **Greenhouse gas:** a gas that traps heat in the atmosphere.
- **Carbon dioxide:** a greenhouse gas released naturally and through human activities.
- **Natural variability:** changes that occur naturally within the climate system.
- **Long-term trend:** a general pattern observed over many years.
- **Cool-season rainfall:** rain received during the cooler months.
- **Intensify:** to become stronger or more severe.
- **Adaptation:** changing practices to reduce harm from present or future conditions.