*Effects of Floods and Droughts*

Water is a very basic necessity for the survival of life on earth. Imagine life with insufficient amount of water, it will be impossible to do the daily activities of cleaning, cooking, drinking etc. Life will turn out to be a miserable chaos. [Water cycle](https://byjus.com/chemistry/water-cycle-process/) has helped in maintaining the quantity of water on the surface of earth. About 50 liters of water is needed per day per person in order to sustain a healthy life. There are many areas where people do not receive this basic quantity of water. Areas that do not receive adequate amount of rainfall and have dry soil suffer from droughts. Whereas areas which receive heavy rainfall and have marshy soil generally get flooded. Floods and droughts are contrary concepts.

The amount of rainfall received by an area varies from one place to another depending on the location of the place. In some places it rains almost throughout the year whereas in other places it might rain for only few days. India records most of its rainfall in the monsoon season. Rains are a big relief after the hot and sunny days of summers. The growth of crops is also dependent on the arrival of monsoons. However excess rainfall is disadvantageous in many ways. Heavy rains lead to rise in the water level of rivers, seas and oceans. Water gets accumulated in the coastal areas which results in floods. These floods caused extensive damage to crops, domestic animals, property and human life. During floods, many animals get carried away by the force of water and eventually die.

If it does not rain for a long period of time, what will happen? The soil will continuously lose groundwater by the process of [evaporation](https://byjus.com/chemistry/evaporation/)and transpiration. Since this water is not brought back to earth in the form of rains, the soil becomes very dry. The level of water in the ponds and rivers goes down and in some cases water bodies get dried up completely. Ground water becomes scarce and this leads to droughts. In drought conditions it is very difficult to get food and fodder for the survival. Life gets difficult and many animals perish in such conditions.

# Drought

A **drought** or **drouth** is an event of prolonged shortages in the water supply, whether atmospheric (below-average [precipitation](https://en.wikipedia.org/wiki/Precipitation)), [surface water](https://en.wikipedia.org/wiki/Surface_water) or [ground water](https://en.wikipedia.org/wiki/Ground_water). A drought can last for months or years, or may be declared after as few as 15 days. It can have a substantial impact on the [ecosystem](https://en.wikipedia.org/wiki/Ecosystem) and [agriculture](https://en.wikipedia.org/wiki/Agriculture) of the affected region and harm to the local [economy](https://en.wikipedia.org/wiki/Economy). Annual dry seasons in the [tropics](https://en.wikipedia.org/wiki/Tropics) significantly increase the chances of a drought developing and subsequent bush fires. Periods of heat can significantly worsen drought conditions by hastening evaporation of [water vapour](https://en.wikipedia.org/wiki/Water_vapour).

Drought is a recurring feature of the climate in most parts of the world.

Many plant species, such as those in the family Cactaceae (or [cacti](https://en.wikipedia.org/wiki/Cactus)), have [drought tolerance](https://en.wikipedia.org/wiki/Drought_tolerant) adaptations like reduced leaf area and waxy cuticles to enhance their ability to tolerate drought. Some others survive dry periods as buried seeds. Semi-permanent drought produces arid biomes such as deserts and grasslands. Prolonged droughts have caused [mass migrations](https://en.wikipedia.org/wiki/Mass_migration) and humanitarian crisis. Most arid ecosystems have inherently low productivity. The most prolonged drought ever in the world in [recorded history](https://en.wikipedia.org/wiki/Recorded_history) occurred in the [Atacama Desert](https://en.wikipedia.org/wiki/Atacama_Desert) in [Chile](https://en.wikipedia.org/wiki/Chile) (400 Years).

Drought affect food production and human society, so they are considered a disaster, of [natural](https://en.wikipedia.org/wiki/Natural_disaster), supernatural or human cause (which itself could be supernatural causes, [malediction](https://en.wikipedia.org/wiki/Curse), [sin](https://en.wikipedia.org/wiki/Sin) ...). It is among the earliest documented climatic events, present in the [Epic of Gilgamesh](https://en.wikipedia.org/wiki/Epic_of_Gilgamesh) and tied to the [Biblical](https://en.wikipedia.org/wiki/Bible) story of [Joseph](https://en.wikipedia.org/wiki/Joseph_%28Hebrew_Bible%29)'s arrival in and the later [Exodus](https://en.wikipedia.org/wiki/The_Exodus) from [Ancient Egypt](https://en.wikipedia.org/wiki/Ancient_Egypt). Hunter-gatherer migrations in 9,500 BC Chile have been linked to the phenomenon, as has the exodus of early humans [out of Africa](https://en.wikipedia.org/wiki/Recent_African_origin_of_modern_humans) and into the rest of the world around 135,000 years ago. [Rituals](https://en.wikipedia.org/wiki/Ritual#Rites_of_affliction) exist to prevent or avert drought, [rainmaking](https://en.wikipedia.org/wiki/Rainmaking_%28ritual%29) could go from dances to [scapegoating](https://en.wikipedia.org/wiki/Scapegoating) to [human sacrifices](https://en.wikipedia.org/wiki/Human_sacrifice). Nowadays, those ancient practices are for the most part relegated to [folklore](https://en.wikipedia.org/wiki/Folklore) and replaced by more rational [water management](https://en.wikipedia.org/wiki/Water_management).

## Types of drought

People tend to define droughts in three main ways:

1. [Meteorological](https://en.wikipedia.org/wiki/Meteorology) drought occurs when there is a prolonged time with less than average precipitation. Meteorological drought usually precedes the other kinds of drought.
2. [Agricultural](https://en.wikipedia.org/wiki/Agriculture) droughts affect crop production or the ecology of the [range](https://en.wikipedia.org/wiki/Range_%28biology%29). This condition can also arise independently from any change in precipitation levels when either increased [irrigation](https://en.wikipedia.org/wiki/Irrigation) or [soil](https://en.wikipedia.org/wiki/Soil) conditions and erosion triggered by poorly planned agricultural endeavors cause a shortfall in water available to the crops. However, in a traditional drought, it is caused by an extended period of below average precipitation.
3. [Hydrological](https://en.wikipedia.org/wiki/Hydrology) drought is brought about when the water reserves available in sources such as [aquifers](https://en.wikipedia.org/wiki/Aquifer), [lakes](https://en.wikipedia.org/wiki/Lake) and [reservoirs](https://en.wikipedia.org/wiki/Reservoir) fall below a [locally significant](https://en.wikipedia.org/wiki/Descriptive_statistics) threshold. Hydrological drought tends to show up more slowly because it involves stored water that is used but not replenished. Like an agricultural drought, this can be triggered by more than just a loss of rainfall. For instance, around 2007 [Kazakhstan](https://en.wikipedia.org/wiki/Kazakhstan) was awarded a large amount of money by the [World Bank](https://en.wikipedia.org/wiki/World_Bank) to restore water that had been diverted to other nations from the [Aral Sea](https://en.wikipedia.org/wiki/Aral_Sea) under [Soviet](https://en.wikipedia.org/wiki/Soviet_Union) rule. Similar circumstances also place their largest lake, [Balkhash](https://en.wikipedia.org/wiki/Lake_Balkhash), at risk of completely drying out.

As a drought persists, the conditions surrounding it gradually worsen and its impact on the local population gradually increases.

## Causes of drought

### Precipitation deficiency

*See also:*[*Precipitation*](https://en.wikipedia.org/wiki/Precipitation)

Mechanisms of producing precipitation include [convective](https://en.wikipedia.org/wiki/Convective), [stratiform](https://en.wikipedia.org/wiki/Stratus_cloud), and [orographic](https://en.wikipedia.org/wiki/Orographic_lift) rainfall. Convective processes involve strong vertical motions that can cause the overturning of the atmosphere in that location within an hour and cause heavy precipitation,  while stratiform processes involve weaker upward motions and less intense precipitation over a longer duration. Precipitation can be divided into three categories, based on whether it falls as liquid water, liquid water that freezes on contact with the surface, or ice. Droughts occur mainly in areas where normal levels of rainfall are, in themselves, low. If these factors do not support precipitation volumes sufficiently to reach the surface over a sufficient time, the result is a drought. Drought can be triggered by a high level of reflected sunlight and above average prevalence of high [pressure systems](https://en.wikipedia.org/wiki/Pressure_system), [winds](https://en.wikipedia.org/wiki/Wind) carrying continental, rather than oceanic air masses, and ridges of [high pressure areas](https://en.wikipedia.org/wiki/High_pressure_area) aloft can prevent or restrict the developing of thunderstorm activity or rainfall over one certain region. Once a region is within drought, feedback mechanisms such as local arid air, hot conditions which can promote warm core ridging,  and minimal evapotranspiration can worsen drought conditions.



President [Barack Obama](https://en.wikipedia.org/wiki/Barack_Obama) discussing the [drought in California](https://en.wikipedia.org/wiki/2011%E2%80%932017_California_drought) with farmers, 2014

#### Dry season

*See also:*[*Dry season*](https://en.wikipedia.org/wiki/Dry_season)

Within the tropics, distinct, [wet](https://en.wikipedia.org/wiki/Wet_season) and dry [seasons](https://en.wikipedia.org/wiki/Season) emerge due to the movement of the [Intertropical Convergence Zone](https://en.wikipedia.org/wiki/Intertropical_Convergence_Zone) or [Monsoon trough](https://en.wikipedia.org/wiki/Monsoon_trough). The dry season greatly increases drought occurrence, and is characterized by its low humidity, with watering holes and rivers drying up. Because of the lack of these watering holes, many grazing animals are forced to migrate due to the lack of water in search of more fertile lands. Examples of such animals are [zebras](https://en.wikipedia.org/wiki/Zebras), [elephants](https://en.wikipedia.org/wiki/Elephants), and [wildebeest](https://en.wikipedia.org/wiki/Wildebeest). Because of the lack of water in the plants, bushfires are common. Since water vapor becomes more energetic with increasing temperature, more water vapor is required to increase relative humidity values to 100% at higher temperatures (or to get the temperature to fall to the dew point). Periods of warmth quicken the pace of fruit and vegetable production, increase evaporation and transpiration from plants, and worsen drought conditions.

#### El Niño



Regional impacts of warm ENSO episodes ([El Niño](https://en.wikipedia.org/wiki/El_Ni%C3%B1o))

*See also:*[*El Niño*](https://en.wikipedia.org/wiki/El_Ni%C3%B1o)

Drier and hotter weather occurs in parts of the [Amazon River](https://en.wikipedia.org/wiki/Amazon_River) Basin, [Colombia](https://en.wikipedia.org/wiki/Colombia), and [Central America](https://en.wikipedia.org/wiki/Central_America) during El Niño events. Winters during the El Niño are warmer and drier than average conditions in the Northwest, northern Midwest, and northern Mideast United States, so those regions experience reduced snowfalls. Conditions are also drier than normal from December to February in south-central Africa, mainly in [Zambia](https://en.wikipedia.org/wiki/Zambia), [Zimbabwe](https://en.wikipedia.org/wiki/Zimbabwe), [Mozambique](https://en.wikipedia.org/wiki/Mozambique), and [Botswana](https://en.wikipedia.org/wiki/Botswana). Direct effects of El Niño resulting in drier conditions occur in parts of [Southeast Asia](https://en.wikipedia.org/wiki/Southeast_Asia) and [Northern Australia](https://en.wikipedia.org/wiki/Northern_Australia), increasing [bush fires](https://en.wikipedia.org/wiki/Bush_fire), worsening [haze](https://en.wikipedia.org/wiki/Haze), and decreasing air quality dramatically. Drier-than-normal conditions are also in general observed in [Queensland](https://en.wikipedia.org/wiki/Queensland), inland [Victoria](https://en.wikipedia.org/wiki/Victoria_%28Australia%29), inland [New South Wales](https://en.wikipedia.org/wiki/New_South_Wales), and eastern [Tasmania](https://en.wikipedia.org/wiki/Tasmania) from June to August. As warm water spreads from the west Pacific and the [Indian Ocean](https://en.wikipedia.org/wiki/Indian_Ocean) to the east Pacific, it causes extensive drought in the western Pacific. Singapore experienced the driest February in 2014 since records began in 1869, with only 6.3 mm of rain falling in the month and temperatures hitting as high as 35 °C on 26 February. The years 1968 and 2005 had the next driest Februaries, when 8.4 mm of rain fell.

### Erosion and human activities

*See also:*[*Aeolian processes*](https://en.wikipedia.org/wiki/Aeolian_processes)

Human activity can directly trigger exacerbating factors such as over farming, excessive [irrigation](https://en.wikipedia.org/wiki/Irrigation), [deforestation](https://en.wikipedia.org/wiki/Deforestation), and [erosion](https://en.wikipedia.org/wiki/Erosion) adversely impact the ability of the land to capture and hold water. In arid climates, the main source of erosion is wind. Erosion can be the result of material movement by the wind. The wind can cause small particles to be lifted and therefore moved to another region (deflation). Suspended particles within the wind may impact on solid objects causing erosion by abrasion (ecological succession). Wind erosion generally occurs in areas with little or no vegetation, often in areas where there is insufficient rainfall to support vegetation.



Fields outside [Benambra, Victoria](https://en.wikipedia.org/wiki/Benambra%2C_Victoria), [Australia](https://en.wikipedia.org/wiki/Australia) suffering from drought conditions in 2006.

[Loess](https://en.wikipedia.org/wiki/Loess) is a homogeneous, typically nonstratified, porous, [friable](https://en.wikipedia.org/wiki/Friable), slightly coherent, often calcareous, fine-grained, [silty](https://en.wikipedia.org/wiki/Silt), pale yellow or buff, windblown ([Aeolian](https://en.wikipedia.org/wiki/Aeolian_processes)) [sediment](https://en.wikipedia.org/wiki/Sediment). It generally occurs as a widespread blanket deposit that covers areas of hundreds of square kilometers and tens of meters thick. Loess often stands in either steep or vertical faces. Loess tends to develop into highly rich soils. Under appropriate climatic conditions, areas with loess are among the most agriculturally productive in the world. Loess deposits are geologically unstable by nature, and will erode very readily. Therefore, windbreaks (such as big trees and bushes) are often planted by farmers to reduce the wind erosion of loess. Wind erosion is much more severe in arid areas and during times of drought. For example, in the [Great Plains](https://en.wikipedia.org/wiki/Great_Plains), it is estimated that soil loss due to wind erosion can be as much as 6100 times greater in drought years than in wet years.

### Climatic changes

*See also:*[*Climate change*](https://en.wikipedia.org/wiki/Climate_change)

Overall, global warming will result in increased world rainfall. Activities resulting in global [climate change](https://en.wikipedia.org/wiki/Climate_change) are expected to trigger droughts with a [substantial impact on agriculture](https://en.wikipedia.org/wiki/Climate_change_and_agriculture) throughout the world, and especially in [developing nations](https://en.wikipedia.org/wiki/Developing_nation). Along with drought in some areas, flooding and erosion could increase in others. Some proposed [solutions to global warming](https://en.wikipedia.org/wiki/Mitigation_of_global_warming) that focus on more active techniques, [solar radiation management](https://en.wikipedia.org/wiki/Solar_radiation_management) through the use of a [space sunshade](https://en.wikipedia.org/wiki/Space_sunshade) for one, may also carry with them increased chances of drought.

According to the [Special Report on Climate Change and Land](https://en.wikipedia.org/wiki/Special_Report_on_Climate_Change_and_Land) of the [Intergovernmental Panel on Climate Change](https://en.wikipedia.org/wiki/Intergovernmental_Panel_on_Climate_Change) climate change increase drought and desertification. Hundreds of million people are affected. The affected area includes large territories in Africa, Asia, Australia, South America

## Consequences of drought



Pair of dead Oryx in Namibia during the [2018–19 Southern Africa drought](https://en.wikipedia.org/wiki/2018%E2%80%9319_Southern_Africa_drought).

One can divide the effects of droughts and water shortages into three groups: environmental, economic and social.

* In the case of environmental effects: lower surface and subterranean water-levels, lower flow-levels (with a decrease below the minimum leading to direct danger for amphibian life), increased pollution of surface water, the drying out of wetlands, more and larger fires, higher deflation intensity, [loss of biodiversity](https://en.wikipedia.org/wiki/Biodiversity_loss), worse health of trees and the appearance of pests and dendroid diseases.
* Economic losses include lower agricultural, forests, game and fishing output, higher food-production costs, lower energy-production levels in hydro plants, losses caused by depleted water tourism and transport revenue, problems with water supply for the energy sector and for technological processes in metallurgy, mining, the chemical, paper, wood, foodstuff industries etc., disruption of water supplies for municipal economies.
* Social costs include the negative effect on the health of people directly exposed to this phenomenon (excessive heat waves), possible limitation of water supplies, increased pollution levels, high food-costs, stress caused by failed harvests, etc. This explains why droughts and fresh water shortages operate as a factor which increases the gap between developed and developing countries.

Effects vary according to vulnerability. For example, subsistence farmers are more likely to migrate during drought because they do not have alternative food-sources. Areas with populations that depend on water sources as a major food-source are more vulnerable to famine.

Drought can also reduce water quality, because lower water-flows reduce dilution of pollutants and increase [contamination](https://en.wikipedia.org/wiki/Contamination) of remaining water-sources. Common consequences of drought include:

* Diminished [crop growth or yield productions](https://en.wikipedia.org/wiki/Crop_yield) and [carrying capacity](https://en.wikipedia.org/wiki/Carrying_capacity) for [livestock](https://en.wikipedia.org/wiki/Livestock)
* [Dust bowls](https://en.wikipedia.org/wiki/Dust_bowl), themselves a sign of [erosion](https://en.wikipedia.org/wiki/Erosion), which further erode the [landscape](https://en.wikipedia.org/wiki/Landscape)
* [Dust storms](https://en.wikipedia.org/wiki/Dust_storms), when drought hits an area suffering from desertification and [erosion](https://en.wikipedia.org/wiki/Erosion)
* [Famine](https://en.wikipedia.org/wiki/Famine)
* [Habitat](https://en.wikipedia.org/wiki/Habitat) damage, affecting both [terrestrial](https://en.wikipedia.org/wiki/Terrestrial_ecoregion) and [aquatic](https://en.wikipedia.org/wiki/Aquatic_ecosystem) wildlife
* [Hunger](https://en.wikipedia.org/wiki/Hunger) – drought provides too little water to support food crops.
* [Malnutrition](https://en.wikipedia.org/wiki/Malnutrition), [dehydration](https://en.wikipedia.org/wiki/Dehydration) and related diseases
* [Mass migration](https://en.wikipedia.org/wiki/Mass_migration), resulting in [internal displacement](https://en.wikipedia.org/wiki/Internally_displaced_person) and international [refugees](https://en.wikipedia.org/wiki/Refugee)
* Reduced [electricity production](https://en.wikipedia.org/wiki/Electricity_generation) due to reduced water-flow through [hydroelectric](https://en.wikipedia.org/wiki/Hydroelectric_energy) [dams](https://en.wikipedia.org/wiki/Dam)
* Shortages of water for [industrial](https://en.wikipedia.org/wiki/Industry) users
* [Snake](https://en.wikipedia.org/wiki/Snake) migration, which results in snake-bites
* Social [unrest](https://en.wikipedia.org/wiki/Unrest)
* [War](https://en.wikipedia.org/wiki/War) over natural resources, including water and food
* [Wildfires](https://en.wikipedia.org/wiki/Wildfires), such as [Australian](https://en.wikipedia.org/wiki/Australia) [bushfires](https://en.wikipedia.org/wiki/Bushfire), become more common during times of drought and may cause human deaths.
* Exposure and oxidation of [acid sulfate soils](https://en.wikipedia.org/wiki/Acid_sulfate_soils) due to falling surface- and ground-water levels.
* [Cyanotoxin](https://en.wikipedia.org/wiki/Cyanotoxin) accumulation within food chains and water supply (some of which are among the most potent toxins known to science) can cause cancer with low exposure over the long term. High levels of [microcystin](https://en.wikipedia.org/wiki/Microcystin) appeared in [San Francisco Bay Area](https://en.wikipedia.org/wiki/San_Francisco_Bay_Area) salt-water shellfish and fresh-water supplies throughout the state of California in 2016.

## Globally



A South Dakota farm during the [Dust Bowl](https://en.wikipedia.org/wiki/Dust_Bowl), 1936

### Examples

*Main article:*[*List of droughts*](https://en.wikipedia.org/wiki/List_of_droughts)

Well-known historical droughts include:

* 1540 Central Europe, said to be the “worst drought of the millennium” with eleven months without rain and temperatures of five to seven °C above the average of the 20th century
* 1900 India killing between 250,000 and 3.25 million.
* 1921–22 Soviet Union in which over 5 million perished from starvation due to drought
* 1928–30 Northwest China resulting in over 3 million deaths by famine.
* 1936 and 1941 Sichuan Province China resulting in 5 million and 2.5 million deaths respectively.
* The 1997–2009 [Millennium Drought](https://en.wikipedia.org/wiki/2000s_Australian_drought) in Australia led to a water supply crisis across much of the country. As a result, many desalination plants were built for the first time ([see list](https://en.wikipedia.org/wiki/List_of_desalination_plants_in_Australia)).
* In 2006, Sichuan Province China experienced its worst drought in modern times with nearly 8 million people and over 7 million cattle facing water shortages.
* 12-year drought that was devastating southwest Western Australia, southeast South Australia, Victoria and northern Tasmania was "very severe and without historical precedent".
* 2015–2018 [Cape Town water crisis](https://en.wikipedia.org/wiki/Cape_Town_water_crisis). This likelihood was tripled by climate change



Affected areas in the western [Sahel](https://en.wikipedia.org/wiki/Sahel) belt during the [2012 drought](https://en.wikipedia.org/wiki/2012_Sahel_drought).

The Darfur conflict in [Sudan](https://en.wikipedia.org/wiki/Sudan), also affecting [Chad](https://en.wikipedia.org/wiki/Chad), was fueled by decades of drought; combination of drought, [desertification](https://en.wikipedia.org/wiki/Desertification) and [overpopulation](https://en.wikipedia.org/wiki/Human_overpopulation) are among the causes of the Darfur conflict, because the [Arab](https://en.wikipedia.org/wiki/Arab) [Baggara](https://en.wikipedia.org/wiki/Baggara) [nomads](https://en.wikipedia.org/wiki/Nomads) searching for water have to take their livestock further south, to land mainly occupied by non-Arab farming people.

Approximately 2.4 billion people live in the [drainage basin](https://en.wikipedia.org/wiki/Drainage_basin) of the Himalayan rivers. [India](https://en.wikipedia.org/wiki/India), [China](https://en.wikipedia.org/wiki/China), [Pakistan](https://en.wikipedia.org/wiki/Pakistan), [Bangladesh](https://en.wikipedia.org/wiki/Bangladesh), [Nepal](https://en.wikipedia.org/wiki/Nepal) and [Myanmar](https://en.wikipedia.org/wiki/Myanmar) could experience floods followed by droughts in coming decades. [Drought in India](https://en.wikipedia.org/wiki/Drought_in_India) affecting the Ganges is of particular concern, as it provides [drinking water](https://en.wikipedia.org/wiki/Drinking_water) and agricultural [irrigation](https://en.wikipedia.org/wiki/Irrigation) for more than 500 million people. The west coast of [North America](https://en.wikipedia.org/wiki/North_America), which gets much of its water from glaciers in mountain ranges such as the [Rocky Mountains](https://en.wikipedia.org/wiki/Rocky_Mountains) and [Sierra Nevada](https://en.wikipedia.org/wiki/Sierra_Nevada_%28U.S.%29), also would be affected.



Drought affected area in [Karnataka](https://en.wikipedia.org/wiki/Karnataka), [India](https://en.wikipedia.org/wiki/India) in 2012.

In 2005, parts of the [Amazon basin](https://en.wikipedia.org/wiki/Amazon_basin) experienced the worst drought in 100 years. A 23 July 2006 article reported [Woods Hole Research Center](https://en.wikipedia.org/wiki/Woods_Hole_Research_Center) results showing that the forest in its present form could survive only three years of drought. Scientists at the Brazilian [National Institute of Amazonian Research](https://en.wikipedia.org/wiki/National_Institute_of_Amazonian_Research) argue in the article that this drought response, coupled with the effects of [deforestation](https://en.wikipedia.org/wiki/Deforestation) on regional climate, are pushing the rainforest towards a "[tipping point](https://en.wikipedia.org/wiki/Tipping_point_%28climatology%29)" where it would irreversibly start to die. It concludes that the [rainforest](https://en.wikipedia.org/wiki/Rainforest) is on the brink of being turned into [savanna](https://en.wikipedia.org/wiki/Savanna) or [desert](https://en.wikipedia.org/wiki/Desert), with catastrophic consequences for the world's climate. According to the [WWF](https://en.wikipedia.org/wiki/World_Wide_Fund_for_Nature), the combination of [climate change](https://en.wikipedia.org/wiki/Climate_change) and deforestation increases the drying effect of dead trees that fuels forest fires.



[Lake Chad](https://en.wikipedia.org/wiki/Lake_Chad) in a 2001 satellite image. The lake has shrunk by 95% since the 1960s.

By far the largest part of [Australia](https://en.wikipedia.org/wiki/Australia) is [desert](https://en.wikipedia.org/wiki/Deserts_of_Australia) or semi-arid lands commonly known as the [outback](https://en.wikipedia.org/wiki/Outback). A 2005 study by Australian and American researchers investigated the desertification of the interior, and suggested that one explanation was related to [human](https://en.wikipedia.org/wiki/Human) settlers who arrived about 50,000 years ago. Regular burning by these settlers could have prevented [monsoons](https://en.wikipedia.org/wiki/Monsoon) from reaching interior Australia. In June 2008 it became known that an expert panel had warned of long term, maybe irreversible, severe ecological damage for the whole [Murray-Darling basin](https://en.wikipedia.org/wiki/Murray-Darling_basin) if it did not receive sufficient water by October 2008. Australia could experience more severe droughts and they could become more frequent in the future, a government-commissioned report said on July 6, 2008. Australian environmentalist [Tim Flannery](https://en.wikipedia.org/wiki/Tim_Flannery), predicted that unless it made drastic changes, [Perth](https://en.wikipedia.org/wiki/Perth%2C_Western_Australia) in [Western Australia](https://en.wikipedia.org/wiki/Western_Australia) could become the world's first [ghost metropolis](https://en.wikipedia.org/wiki/Ghost_town), an abandoned city with no more water to sustain its population. The long Australian [Millennial drought](https://en.wikipedia.org/wiki/2000s_Australian_drought) broke in 2010.

Recurring droughts leading to [desertification](https://en.wikipedia.org/wiki/Desertification) in [East Africa](https://en.wikipedia.org/wiki/East_Africa) have created grave ecological catastrophes, prompting food shortages in [1984–85](https://en.wikipedia.org/wiki/1983%E2%80%9385_famine_in_Ethiopia), [2006](https://en.wikipedia.org/wiki/2006_Horn_of_Africa_food_crisis) and [2011](https://en.wikipedia.org/wiki/2011_East_Africa_drought). During the 2011 drought, an estimated 50,000 to 150,000 people were reported to have died, though these figures and the extent of the crisis are disputed. In February 2012, the UN announced that the crisis was over due to a scaling up of relief efforts and a bumper harvest. Aid agencies subsequently shifted their emphasis to recovery efforts, including digging irrigation canals and distributing plant seeds.

In 2012, a severe [drought](https://en.wikipedia.org/wiki/2012_Sahel_drought) struck the western [Sahel](https://en.wikipedia.org/wiki/Sahel). The [Methodist Relief & Development Fund (MRDF)](https://en.wikipedia.org/wiki/Methodist_Relief_%26_Development_Fund_%28MRDF%29) reported that more than 10 million people in the region were at risk of famine due to a month-long heat wave that was hovering over [Niger](https://en.wikipedia.org/wiki/Niger), [Mali](https://en.wikipedia.org/wiki/Mali), [Mauritania](https://en.wikipedia.org/wiki/Mauritania) and [Burkina Faso](https://en.wikipedia.org/wiki/Burkina_Faso). A fund of about £20,000 was distributed to the drought-hit countries.

## Protection, mitigation and relief



Succulent plants are well-adapted to survive long periods of drought.



Water distribution on [Marshall Islands](https://en.wikipedia.org/wiki/Marshall_Islands) during [El Niño](https://en.wikipedia.org/wiki/El_Ni%C3%B1o-Southern_Oscillation).

Agriculturally, people can effectively mitigate much of the impact of drought through irrigation and crop rotation. Failure to develop adequate drought mitigation strategies carries a grave human cost in the modern era, exacerbated by [ever-increasing](https://en.wikipedia.org/wiki/Population_growth) population densities. President Roosevelt on April 27, 1935, signed documents creating the Soil Conservation Service (SCS)—now the Natural Resources Conservation Service (NRCS). Models of the law were sent to each state where they were enacted. These were the first enduring practical programs to curtail future susceptibility to drought, creating agencies that first began to stress soil conservation measures to protect farm lands today. It was not until the 1950s that there was an importance placed on water conservation was put into the existing laws (NRCS 2014).



Aerosols over the Amazon each September for four burning seasons (2005 through 2008) during the [Amazon basin](https://en.wikipedia.org/wiki/Amazon_basin) drought. The aerosol scale (yellow to dark reddish-brown) indicates the relative amount of particles that absorb sunlight.

Strategies for drought protection, mitigation or relief include:

* [Dams](https://en.wikipedia.org/wiki/Dam) – many dams and their associated reservoirs supply additional water in times of drought.
* [Cloud seeding](https://en.wikipedia.org/wiki/Cloud_seeding) – a form of intentional weather modification to induce rainfall. This remains a hotly debated topic, as the [United States National Research Council](https://en.wikipedia.org/wiki/National_Research_Council_%28United_States%29) released a report in 2004 stating that to date; there is still no convincing scientific proof of the efficacy of intentional weather modification.
* [Desalination](https://en.wikipedia.org/wiki/Desalination) – use of sea water for irrigation or consumption.
* Drought monitoring – Continuous observation of rainfall levels and comparisons with current usage levels can help prevent man-made drought. For instance, analysis of water usage in [Yemen](https://en.wikipedia.org/wiki/Yemen) has revealed that their [water table](https://en.wikipedia.org/wiki/Water_table) (underground water level) is put at grave risk by over-use to fertilize their [Khat](https://en.wikipedia.org/wiki/Khat) crop. Careful monitoring of moisture levels can also help predict increased risk for wildfires, using such metrics as the [Keetch-Byram Drought Index](https://en.wikipedia.org/wiki/Keetch-Byram_Drought_Index) or [Palmer Drought Index](https://en.wikipedia.org/wiki/Palmer_Drought_Index).
* Land use – Carefully planned [crop rotation](https://en.wikipedia.org/wiki/Crop_rotation) can help to minimize [erosion](https://en.wikipedia.org/wiki/Erosion) and allow farmers to plant less water-dependent crops in drier years.
* [Outdoor water-use restriction](https://en.wikipedia.org/wiki/Outdoor_water-use_restriction) – Regulating the use of sprinklers, hoses or buckets on outdoor plants, filling pools, and other water-intensive home maintenance tasks. [Xeriscaping](https://en.wikipedia.org/wiki/Xeriscaping) yards can significantly reduce unnecessary water use by residents of towns and cities.
* [Rainwater harvesting](https://en.wikipedia.org/wiki/Rainwater_harvesting) – Collection and storage of rainwater from roofs or other suitable catchments.
* [Recycled water](https://en.wikipedia.org/wiki/Recycled_water) – Former wastewater (sewage) that has been treated and purified for reuse.
* [Transvasement](https://en.wikipedia.org/wiki/Transvasement) – Building canals or redirecting rivers as massive attempts at [irrigation](https://en.wikipedia.org/wiki/Irrigation) in drought-prone areas.