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# Drought

This Science Note is one of a series of short guides covering a range of natural hazards. These guides aim to provide non-experts with a brief introduction to each hazard and to highlight key aspects that may need to be taken into account in decision-making during an emergency involving this hazard. They are not intended to be fully comprehensive, detailed analyses or to indicate what will happen on any particular occasion. Instead they will signpost issues that are likely to be important and provide links to sources of more detailed information.

## What is Drought?

A drought is a period of water shortage for people, the environment, agriculture or industry. A hot, dry summer is an example of a short, intense drought; and dry winters can have a big impact on water resources<sup>(1)</sup>. Droughts are different to other weather hazards in that they tend to develop slowly, over a large area, with the exact beginning and end often difficult to identify. Several factors play a part<sup>(2)</sup> including:

- Lack of rainfall
- An environment, soil or bedrock, which is poor at retaining water or lacks underground storage
- Hot weather, which increases evaporation of water

## How does Drought affect the UK?

Drought impacts on a very wide range of sectors including agriculture, industry, water supply, fisheries, health, environment, infrastructure, and the economy. The impacts of droughts are poorly documented in the scientific literature and it is often associated with potential risks, in particular on sectors such as health and water supply. Due to the globalised market, UK impacts can be associated with droughts happening elsewhere, e.g. higher food price<sup>(3)</sup> when drought affect food-producing areas (e.g. 2012 drought in the US and Eastern Europe). Whether or not these become actual risks depends on several factors including:

- **Preparedness for drought**

Drought forecasting is notoriously difficult to do because of the long time scales involved (months to years). Recent work has shown little skill in forecasting beyond about one month ahead<sup>(4)</sup> but knowing the state of water storage (e.g. underground) helps to identify the likelihood of drought developing. Research continues on this subject. However, advance warning would enable better planning and actions aimed at minimising the adverse effects of drought.



- **Vulnerability to drought**

The effects of drought on a water resource system, environments or population health can vary based on the context of where and when drought occurs; certain systems are more likely to be affected e.g. those whose systems depend on heavy water use and/or have little buffering capacity. Vulnerability increases when droughts happen in quick succession as the system does not have time to fully recover (e.g. freshwater and terrestrial ecosystems).

- **Risk reduction during a drought**

Even during a drought, much can be done. For example, hosepipe bans and similar water use restrictions ensure that available water goes further and remains sufficient to meet essential needs. Communities can engage in water conservation activities to minimise waste of water year-round, and especially during a drought; see the Environment Agency for more detailed suggestions: [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/440728/National\\_Drought\\_Framework.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/440728/National_Drought_Framework.pdf) . Scottish Water also offers advice on using water wisely (<http://www.scottishwater.co.uk/you-and-your-home/your-home/water-efficiency> ).

There are various additional sources of information on the evolution and impacts of drought:

- The Environment Agency produces maps of drought affected areas and the management framework for drought in the UK: <http://www.environment-agency.gov.uk/homeandleisure/drought/default.aspx>
- Scottish Water and SEPA issue press releases when there is a drought situation developing (<http://www.scottishwater.co.uk/you-and-your-home> ) and SEPA is producing a national drought plan to support the River Basin Management Plans UK Water companies have more detailed local information and guidance: <http://www.water-guide.org.uk/companies.html>
- The Natural Hydrological Monitoring Programme publishes every month a hydrological summary reporting current status of rivers, aquifers and reservoirs compared to the historical average: <http://www.ceh.ac.uk/data/nrfa/nhmp/nhmp.html>

## What are the Impacts of Drought?

There are numerous different types of impact associated with drought. However, in high-income countries, with resilient water supplies and robust sanitation systems, the potential for physical impacts of drought is relatively low. However, its consequences in terms of economic cost can be high. Drought impacts which may be relevant to the UK include:

- **Reduction / loss of agricultural production**

Drought conditions due to rainfall deficit and/or high temperature increase the drying of soils; when both lack of rainfall and high temperatures are combined this impact is amplified. This in turn can reduce crop yield with a potential for loss of crop if conditions last. This impact can be mitigated by irrigation on the condition that water abstraction (from the river or groundwater) is authorised. Agriculture dependant on irrigation might be resilient to short droughts but might become vulnerable when irrigation is not possible. If severe drought is accompanied with high temperature for a long period during the growing season, for example, this could result in loss of perennial crops (e.g. fruit trees).



- **Reduction of water supply**

In the UK, public drinking water supplies are tightly regulated to ensure they are safe. The Drinking Water Inspectorate (DWI) provides independent reassurance that public water supplies in England and Wales are safe and drinking water quality is acceptable to consumers<sup>(6)</sup>. Warnings are issued in case of any problems. Droughts can have a major impact on water supply in the UK, particularly during long-duration events. In the southeast, which is primarily reliant on groundwater supplies, the major vulnerability is multi-season events where groundwater is not replenished in the winter season. Summer droughts can also have a major impact on water supply in regions where resources come mainly from surface reservoirs. In the past drought has had a major impact on the water supply, e.g. in 1976 standpipes were required. However, the UK is now more resilient, but water supplies can still be threatened by long droughts in particular. Private water supplies serve one percent of the population in England and Wales. During a drought, continued vigilance is needed to ensure water remains of adequate quality and quantity<sup>(6, 7)</sup>.

- **Reduction of energy supply**

Some energy production relies on water for cooling capacity. When intake of water is from rivers, reduced river flow could reduce authorised intake volume. If river water temperature is warmer the cooling capacity can be reduced. Warm effluent will increase further water temperature above thresholds in environmental regulation. Energy plants would have to be shut to prevent water temperatures rising further (e.g. France 2003) with potentially severe impacts on freshwater and aquatic ecosystems. In addition, the warm temperatures in the summer are increasingly associated with high energy demand due to the increasing use of air conditioning and refrigerant systems (domestic and industrial), hence potentially amplifying the problem.

- **Environmental impact**

- **Algal blooms**

Warmer water temperature and increase in nutrient loads (which could result from a higher concentration due to lower water flow/volume) can result in algal blooms some of them toxic. This is usually followed by decay which reduces the available dissolved oxygen in the water, and results in poor water quality.

- **Wildfires**

During a drought with high temperatures, soil and vegetation could dry and be vulnerable to wildfire. The risk can be increased due to high numbers of people walking (or otherwise travelling) through dry landscapes, starting fire by inattention or arson. Damage could be prevented by better communication of the risk, and mitigated by faster response and preparedness, such as fire stopping corridors or fire alert patrols.

- **Loss of habitats**

Drought can have a substantial impact on terrestrial and aquatic ecosystems. Contraction in the river network can result in drying up of large reaches of rivers. Even when flow is still present, it may be much reduced (along with water levels and velocities) which can have a major impact on habitat availability. Water quality deterioration (decreased oxygen levels, dilution of pollutants) will also impact on aquatic plants and animals. With reduced water supply from rainfall, river flow or groundwater and increased evaporation, the extent and function of wetlands might be reduced during



droughts. The environmental consequences of drought include loss of habitats for freshwater ecosystems with all its associated wildlife. Drier soils can result in plant communities changing, with potential loss of food and habitats for insects and pollinators.

### – River and lake pollution

Drought conditions can be associated with increased recreational use of lakes and rivers, which can both increase pollution and increase the exposure of the public to the pollutants. Nutrients and pollutants accumulated over the soil during dry episodes are transported to rivers and lakes when droughts break, which can result in chemical concentration peaks into freshwater ecosystems.

### – Soils

Drier soils can change soil chemistry and increase the amount of chemicals reaching water bodies like aquifers, rivers and lakes.

## • Health-related impacts

The health effects of drought are usually indirect, and are seen most often in countries lacking robust health and sanitation systems; the potential for drought-related health effects is low in the UK<sup>(8)</sup>. Health effects which may be relevant for the UK population include:

### – Algal blooms

Some algal blooms and their surface scum, which grow on open waters and are often blown onto shorelines, can release toxins which adversely affect human and animal health<sup>(9)</sup>. Symptoms following recreational exposure to toxins include skin and eye irritation, respiratory features (e.g. sore throat and cough and hay fever/asthma-like symptoms) and gastrointestinal effects from ingestion of contaminated water (e.g. abdominal pain, nausea, vomiting and diarrhoea. Water treatment removes algal bloom contamination from drinking water.

### – Injury

Drought conditions increase the risk of shallow water in rivers, reservoirs and other natural bodies of water. Diving into shallow water can cause injury, including serious spinal injury leading to lifelong paralysis. Co-incident high temperatures may tempt people to swim in unknown waters, of unknown depth, with unknown hazards hidden just beneath the surface.

### – Mental health and wellbeing

Drought can be difficult for those whose livelihood or lifestyle depends on water. If drought conditions continue and worsen then, for example, farmers and rural populations may experience stress related to financial worries and employment uncertainty.

### – Dust-related problems

Drought conditions can increase the amount of dust in the environment, which can potentially impact people with pre-existing respiratory conditions. Respiratory conditions could also be affected by the smoke and ash associated with co-incident wildfires.

### – Infectious disease

As the climate continues to change, there is a chance of increased vector-borne disease (such as West Nile Virus) associated with drought. Research continues on this subject.

Hand-washing should be conducted as usual, regardless of drought conditions, as it is one of the most effective ways to prevent transmission of infectious diseases.

## Who is Vulnerable to Drought?

The magnitude and long term damaging impact of droughts depends on the vulnerability of the system. This can be linked to the infrastructure (e.g. in water supply and agriculture), the society (level of demand and willingness to change behaviour) or the natural environment (e.g. presence of aquifers, underlying climate or vegetation). Vulnerability also depends on the type of drought; its duration, spatial extent, when it occurs, associated water deficit and temperatures and on the level of preparedness (e.g. hose-pipe bans are issued to mitigate a potential future lack of water).

## Timeline of an Event

The nature of drought means that no two events are the same in terms of their spatial extent, their duration and their impacts. However, we can identify two broad types: A dry summer associated with a heat-wave can have a severe but short impact if autumn rainfall levels are healthy. A dry winter will reduce the natural re-filling of water storages (aquifers, reservoirs) and if followed by a dry spring and summer can have a long-lasting impact. When rainfall levels are below average over several seasons, droughts can become multi-annual with severe consequences for water supply.

## Historic Examples

There have been many examples of drought events in the UK including:

- **1976:** The 1975-76 drought was considered at the time to be the most severe experienced across much of the UK. Given its extreme intensity and broad spatial extent, the documentation of the drought remains relatively limited; this is particularly true in relation to material reviewing the wide range of its impacts<sup>(10)</sup>. The exceptionally dry period, which started in May 1975 and ended in September 1976, caused depletion of surface water and groundwater supplies over most of England and Wales. Scotland and Northern Ireland were much less affected. The drought seriously reduced agricultural production and affected the industrial use of water. It restricted navigation, damaged buildings, made householders become very cautious in their use of water and proved a severe test for the water authorities. In terms of impacts on public health there are suggestions that diarrhoea and vomiting in children was more prevalent in areas with drought-related water restrictions were in place<sup>(11)</sup>.
- **1988-1992:** The period between November 1988 and February 1992 was, at the time, the fourth driest such period recorded and the second warmest. The number of Drought Orders issued was the highest ever during a 3-year period, and these, along with hosepipe bans were used widely through the summer of 1989, affecting 12.5 million consumers<sup>(12)</sup>. By the end of May 1990 hosepipe bans and restrictions on garden sprinklers were in place across most of southern England, affecting 18 million consumers by the end of August 1990. There were some restrictions to the use of water for spray irrigation in East Anglia.

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