MH0035 / **METEOROLOGICAL AND HYDROLOGICAL / Precipitation-Related**

Drought

Definition

A drought is a period of abnormally dry weather characterised by a prolonged deficiency of precipitation below a certain threshold over a large area and a period longer than a month (WMO, 2020).

Reference

WMO, 2020. Guidelines on the Definition and Monitoring of Extreme Weather and Climate Events. World Meteorological Organization (WMO). Final version forthcoming. www.wmo.int/pages/prog/wcp/ccl/documents/GUIDELINESONTHEDEFINTIONANDMONITORING OFEXTREMEWEATHERANDCLIMATEEVENTS_09032018.pdf Accessed 18 November 2019.

Annotations

Synonyms

Not identified.

Additional scientific description

Drought is described as conditions that are significantly drier than normal or otherwise limiting moisture availability to a potentially damaging extent (WMO and GWP, 2016) or as conditions where there had been a prolonged absence or marked deficiency of precipitation (WMO/UNESCO, 2012).

Whereas drought may be defined simply as the absence of water, it is a complex phenomenon which is monitored over a number of time scales and often defined according to need. It is a slow-onset phenomenon that gradually intensifies and can impact many sectors of the economy and the environment (Drought Observatory, no date).

Droughts can be characterised in terms of their severity, location, duration and timing. Droughts can arise from a range of hydrometeorological processes that supress precipitation and/or limit surface water or groundwater availability. There are various drought indicators and indices that provide options for identifying the severity, location, duration onset and cessation of such conditions. It is important to note that the impacts of drought can be as varied as the causes of drought. Droughts can adversely affect agriculture and food security, hydropower generation and industry, human and animal health, livelihood security, and personal security and access to education. Such impacts depend on the socio-economic contexts in which droughts occur, in terms of who or what is exposed to the droughts and the specific vulnerabilities of the exposed entities (WMO and GWP, 2016).

The drought community has defined several different types of drought that have can general or specific sector impacts (NOAA, no date b):

- *Meteorological drought*: Occurs when dry weather patterns dominate an area. It is defined usually on the basis of the degree of dryness and the duration of the dry period.
- *Hydrological drought*: Occurs when low water supply becomes evident and is associated with the effects of periods of precipitation shortfalls on surface or subsurface water supply.
- *Agricultural drought*: Occurs when agricultural production becomes affected. It focuses on precipitation shortages, differences between actual evapotranspiration, soil water deficits, reduced groundwater and so on.
- *Socioeconomic drought*: Relates the supply and demand of some economic goods with elements of meteorological, hydrological, and agricultural drought. It also occurs when the demand for an economic good exceeds supply as a result of a weather-related shortfall in water supply.

Metrics and numeric limits

Specific indices have been created to assess drought. For example, the Palmer Drought Index and Standardized Precipitation Index (SPI), and advanced complex models (such as the National Land Data Assimilation System [NLDAS] or the Combined Drought Indicator in Europe) (European Drought Observatory, 2019) which calculate soil moisture and other hydrological variables. There are also indices used for water supply forecasting (such as the Surface Water Supply Index [SWSI]), and indices which reflect impacts on vegetation (such as the Vegetation Health Index [VHI] and Vegetation Drought Response Index [VegDRI]) (NOAA, no date c).

Indicators are variables or parameters used to describe drought conditions and these include precipitation, temperature, streamflow, groundwater and reservoir levels, soil moisture and snowpack. Indices are typically computed numerical representations of drought severity, assessed using climatic or hydrometeorological inputs. They aim to measure the qualitative state of droughts on the landscape for a given time period. Indices can simplify complex relationships and provide useful communication tools for diverse audiences and users, including the public. Indices are used to provide quantitative assessment of the severity, location, timing and duration of drought events. Severity refers to the departure from normal of an index. A threshold for severity may be set to determine when a drought has begun, when it ends, and the geographic area affected. Location refers to the geographic area experiencing drought conditions. The timing and duration are determined by the approximate dates of onset and cessation (WMO and GWP, 2016).

The World Meteorological Organization (WMO)'s Handbook of Drought Indicators and Indices provides a compendium of the most commonly used drought indicators/indices that are being applied across drought-prone regions. The indexes are grouped under: meteorology (23 indices); soil moisture (4 indices); hydrology (8 indices); remote-sensing (10 indices); and composite or modelled (5 indices). Each index is elaborated in detail with its origin, characteristics, input parameters, application, strengths, weaknesses, resources, and references (WMO and GWP, 2016). The Handbook includes many commonly used drought indicators/indices such as several versions of the Palmer Drought Indices and the Keetch-Byram Drought Index.

The Standardized Precipitation Index (SPI) is an index that considers only precipitation and it is easy to use. A period of record of at least 30 years of data is recommended, and a shorter period should only be used with caution. The SPI can be very useful when the amount of data for calculations is limited. It is can be easier to communicate in some situations than other more complex indices as it is only based on rainfall received and a comparison with historical rainfall amounts. The SPI is an index based on the probability of receiving a given amount of precipitation, and the probabilities are standardised such that an index of zero indicates the median precipitation amount (half of the historical precipitation amounts are below the median, and half are above the median). The index is negative for drought, and positive for wet conditions. The SPI can be computed from one month to 24 months, to capture both short-term and long-term conditions (WMO, 2012; NOAA, no date c). In June 2011, the Sixteenth World Meteorological Congress adopted a resolution that recommended that the SPI be used by all National Meteorological and Hydrological Services (NMHSs) around the world to characterise meteorological droughts, in addition to other drought indices that were in use in their service (WMO, 2011).

Key relevant UN convention / multilateral treaty

The United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, particularly In Africa (UNCCD, 1994). Established in 1994, the United Nations Convention to Combat Desertification (UNCCD) is the sole legally binding international agreement linking the environment and development to sustainable land management. The Convention addresses specifically the arid, semi-arid and dry sub-humid areas, known as the drylands, where some of the most vulnerable ecosystems and peoples can be found (UNCCD, 2017).

This is the most comprehensive global commitment to achieve Land Degradation Neutrality (LDN) in order to restore the productivity of vast expanses of degraded land, improve the livelihoods of more than 1.3 billion people, and reduce the impacts of drought on vulnerable populations.

The United Nations Watercourses Convention (United Nations, 1997), which entered into force on 17 August 2014.

Examples of drivers, outcomes and risk management

There has been much work on drought management. The Integrated Drought Management Programme (IDMP), co-sponsored by the WMO and the Global Partnership Water (GWP), have developed a three pillar approach to Integrated Drought Management. These pillars include: drought monitoring and early warning; drought vulnerability and impact assessment; and drought mitigation, preparedness and response. IDMP has over 35 partner organisations, including the Food and Agriculture Organization of the United Nations (FAO) and the United Nations Convention to Combat Desertification (UNCCD). IDMP developed the National Drought Management Policy Guidelines, which include a 10-step process to assist countries in developing national drought plans and polices (WMO and GWP, 2014).

Drought can have a serious impact on health, agriculture, economies, energy and the environment. An estimated 55 million people globally are affected by droughts every year, and they are the most serious hazard to livestock and crops in nearly every part of the world. Drought threatens people's livelihoods, increases the risk of disease and death, and drives mass migration. Water scarcity impacts 40% of the world's population, and as many as 700 million people are at-risk of being displaced as a result of drought by 2030 (WHO, no date a).

The probability of drought-related health impacts varies widely and largely depends upon drought severity, baseline population vulnerability, existing health and sanitation infrastructure, and available resources with which to mitigate impacts as they occur (Stanke et al., 2013). When drought causes water and food shortages there can be many impacts on the health of the affected population, which may increase the risk of disease and death. Drought may have acute and chronic health effects, including: malnutrition due to the decreased availability of food, including micronutrient deficiency (such as iron-deficiency anaemia); increased risk of infectious diseases (such as cholera, diarrhoea, and pneumonia), due to acute malnutrition, lack of water and sanitation, and displacement; psycho-social stress and mental health disorders; and disruption of local health services due to a lack of water supplies, loss of buying power, migration and/or health workers being forced to leave local areas. Severe drought can also affect air quality by making wildfires and dust storms more likely, increasing health risk in people already impacted by lung diseases, like asthma or chronic obstructive pulmonary disease (COPD), or with heart disease (WHO, no date a).

As the health cluster lead for global emergencies, the World Health Organization (WHO) works with partners to respond to drought-related disasters. This includes: ensuring appropriate food supplementation; health services, like immunisation, child and maternal health, and mental health; assembling mobile health teams and outreach; epidemic surveillance, early warning and response; and calling for emergency funding to support health action (WHO, no date a).

The WHO provides a useful Technical Hazard Sheet on drought (no date b).

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Coordinating agency or organisation

World Meteorological Organization (WMO).