

# 1 DROUGHT

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A drought is an irregular phenomenon which is described as an extended period of rainfall significantly diminished compared to “normal” for an indefinite period of time.

## 1.1 TERMS RELATED TO DROUGHTS

- Drought
  - o An irregular phenomenon occurring in exceptionally dry years
- Aridity
  - o A permanent shortage of water
    - Caused by a dry climate
- Desertification
  - o A drying of the landscape resulting (generally) from human actions
- Water Stress
  - o Increasing pressure on water sources due to increased water demand
    - This can occur even where there is abundant water

## 1.2 TYPES OF DROUGHTS

- Meteorological
  - o Significant decrease in rainfall over a period of time
- Agricultural/pastoral
  - o Inadequate soil moisture
- Hydrological
  - o Deficiencies in surface or ground water
- Socio-economic
  - o A lack of water resulting in impacts on health, well-being or economic activity
  - o Also known as a famine drought

## 1.3 DROUGHT IN AUSTRALIA

- Australia has a variable climate
  - o Northern Australia has summer rain
    - From air rising over the equator and moving towards the tropics
  - o Southern Australia has winter rain
    - Westerly flow brings rain to southern Australia
  - o Central Australia typically doesn't have much rain
    - This makes central Australia particularly susceptible to drought

## 1.4 CAUSES OF DROUGHTS

- Subsiding high pressure systems producing warming and subsequently less clouds
  - o Anomalies
- Long-term climate variability

- Potentially exacerbated/ accelerated by anthropogenic climate change
- Human factors cannot cause drought but can exacerbate the impacts of droughts
  - Famine
  - Poverty
  - Location
    - Rural vs urban

## 1.5 IMPACTS OF DROUGHTS

Overall, the major impacts of droughts is economic, however, this occurs in different sectors.

- General economic impacts
  - Decreased exports
  - Decreased recreational money
    - Tourism
    - Sports
    - Forestry
  - Decreased employment
    - Particularly in affected economic sectors
- Agricultural
  - Decreased yield
  - Decreased productivity
  - Deaths of livestock
  - Loss of soil nutritional value
  - Loss of topsoil
- Environmental impacts
  - Native species and systems impacted
  - Weed infestation

### Direct human impacts

- The major demographic impacted is those in rural areas
- Urban water scarcity
  - Water restrictions
  - Water reliant businesses
  - 'Browning cities'
    - Gardens
    - Public spaces
- Health impacts
  - Direct deaths
  - Nutrition deficits
    - Weakened immune system
  - Respiratory diseases
  - Involuntary separation

- Linked to unemployment
- Mental health
  - Suicide
  - Psychological poverty
  - Acute stress
  - A general sense of hopelessness
- Drought and famine linked
  - Droughts exacerbate famines but do NOT cause famines

### 1.5.1 Policies to manage droughts

- Protection: Securing a water supply
  - Water tanks
  - Irrigation
  - Bore water
    - In particular in developing countries
  - Dams
  - Desalination plants
- There is a history of drought management plans
  - Overall main message is to increase preparedness
    - Learning to live with dryness
      - Early warning systems
        - Indicators include: rainfall and soil moisture levels
      - Water restrictions
- Land use planning
  - Land use management

## 2 EXTREME HEAT

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**Extreme Heat Events are rare high impact events which occur in the tale ends of probability distributions.**

Changing extremes through:

- Changing the mean
- Changing symmetry
- Changing variability

### 2.1 FACTORS CONTRIBUTING TO EXTREME HEAT AND EXTREME HEAT DEATHS

- Age
- Ageed care facilities
- Emergency response teams
- Ethnicity
- Urban design
- Household size

- Health status
- Population density
- Urban Heat Island
- Land Cover (linked to albedo)

## 2.2 DEATHS FROM EXTREME HEAT

- 2009 Black Saturday: 547 deaths
  - o 66% over 75 years old
- 2003 European Heatwave: 60,000
- Increased deaths related to extreme heat begin with an average temperature of 28-30 degrees (40 degrees during the day and 20 degrees overnight)
  - o At this temperature death rate increases by approximately 17%

### 2.2.1 Why does this occur?

- Humans require a core temperature of around 37 degrees
  - o Humans are *homeotherms* meaning that a stable temperature is required to survive
- When the external environment is too hot, the body is less able to decrease temperature
  - o Heat loss usually occurs through:
    - Sweating → evaporative cooling

## 2.3 THE URBAN HEAT ISLAND

**The Urban Heat Island is why temperatures in cities and built up environments are up to four degrees hotter than rural areas, in particular at night.**

- Factors used to decrease the Urban Heat Island
  - o Water
    - Water is able to cool the surrounding area through evaporation
  - o Vegetation
    - Evapotranspiration of plants contributes to cooling
    - Vegetation also can increase shading which decreases the amount of heat which is able to be absorbed
  - o Increasing albedo
    - Albedo is the reflectivity of incoming solar radiation
      - If more sunlight and therefore heat is reflected, less is absorbed
    - White and light colours have higher albedos
  - o Decreasing waste heat
    - Direct heat transfer from air conditioners, transport (cars) and industry increases heat even without the sun's heat

## 2.4 IMPLEMENTATION OF A HEAT FORECASTING SYSTEM TO COMBAT EXTREME HEAT

- 2014 heat wave similar to 2009 Black Saturday
  - o Deaths increased by 25% on average as compared to 60% on average

- Linked to ability to prepare individuals, communities and hospitals

## **2.5 METHODS UNDERTAKEN TO REDUCE EXTREME HEAT RELATED DEATHS**

- Education
  - Behavioural changes
    - Avoiding activities which are overly strenuous during hot weather
    - Taking measures to remain cool during extreme weather days
    - Recognising the signs of extreme heat