Impact of Climate Change in Southern Africa

There is a plethora of evidence that climate change is affecting countries with the Southern African hemisphere (Rosendo et al. 2018). Climate change gives rise to a wide array of effects, encompassing rising sea levels, heightened intensity of severe weather events like droughts and floods, escalating temperatures that contribute to wildfires, and erratic changes in rainfall patterns (Shiv et. al., 2024). In Southern Africa, the effects of climate change have been experienced at a large scale as the region lacks adequate technology and propermanagement of its resources (Thinda et al. 2020)

Environmental impact of climate change in southern africa

Climate change is amplifying the intensity and frequency of extreme rainfall events in Southern African region especially in countries like South Africa, Malawi, Madagascar and Mozambique (Manhique et. al., 2015). Tropical Rainfall Measuring Mission data and rainfall station records indicate that Malawi and Mozambique received the highest rainfall during the initial phase of tropical storm Chedza (Rapolaki et. al., 2015). This also occurred earlier in January 2013, when there was a very heavy rainfall over central and southern Mozambique (Manhique et. al., 2015). Madagascar, on the other hand, experienced heavy rainfall in January 2015, accounting for approximately 80% of the total rainfall recorded (Rapolaki et. al., 2015). This is a result of the rise in ocean temperature which leads to a higher rate of water vapourizing into the atmosphere (Kevin, 2011). This saturation converges within a storm system and creates the conditions for more ferocious precipitation, that is, stronger rain (Wuebbles et. al., 2017). The depicted graph (figure 1) below illustrates the changes in the average surface temperature of the world's oceans since 1880.

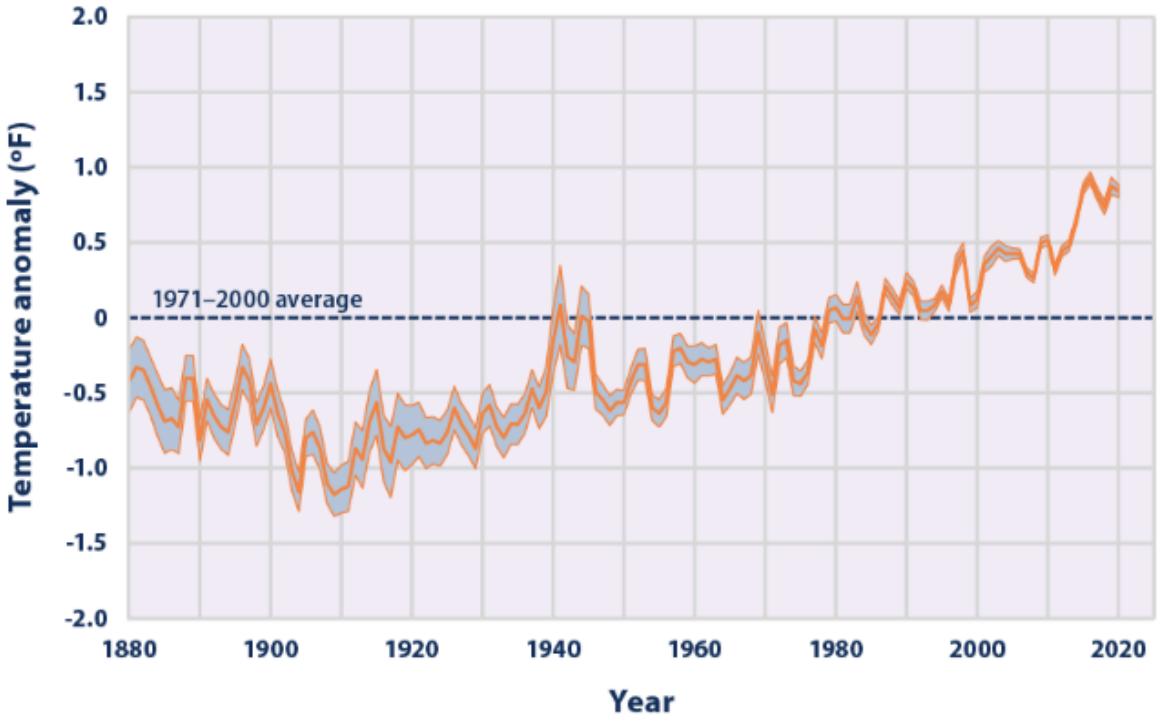


Figure 1. Average Global Sea Surface Temperature, 1880–2020 (NOAA, 2021)

As such, extreme rainfall is intensified with global warming as the concentration of atmospheric water vapour which supplies the water for precipitation increases in proportion to saturation concentrations at a rate of about 6–7% per degree rise in temperature according to the thermodynamic Clausius–Clapeyron relationship (Ingram, 2016). This relationship is illustrated in a study by Allen et. al. (2002) and presented below (figure 2) using scatter plots to represent global-mean temperature and precipitation changes as it follows the Clausius–Clapeyron relation.

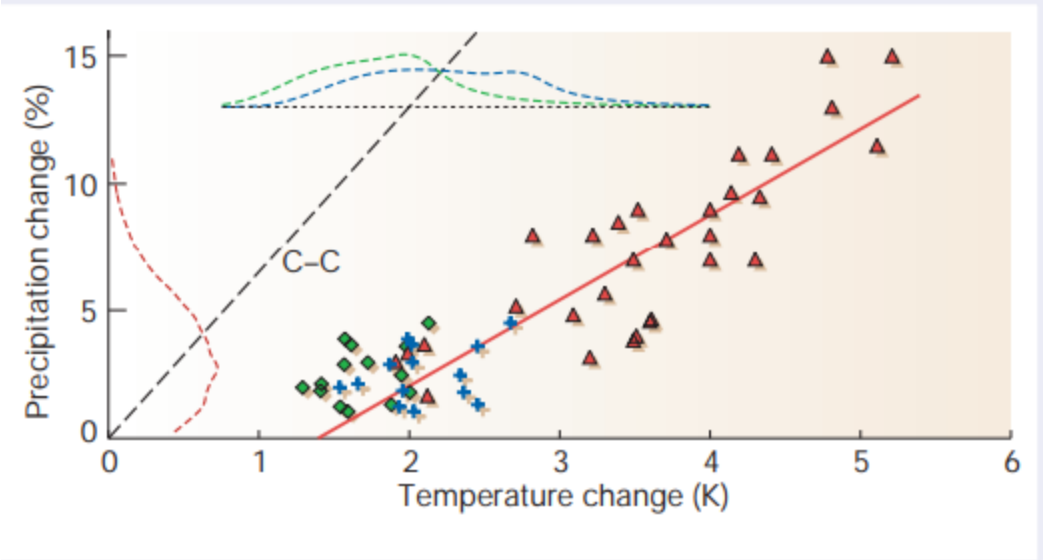


Figure 2: Global-mean temperature and precipitation changes in AOGCM simulations (Allen et. al., 2002)

"Drought is another consequence of climate change. According to the United Nations Development Programme (UNDP), drought is recognised as one of the most severe climate-related challenges, particularly in Southern Africa, due to its significant socio-economic impacts (UNDP, 2021)." Numerous Southern African nations faced a widespread drought in 2019 after enduring an extended period of dry conditions from 2014 to 2016, with South Africa having the most drought situations (Chivangulula et. al., 2023). Drought occurs from insufficient rainfall or excessive evaporation, resulting in significant hydrological imbalances (Babugura, 2024). Also, during warm ENSO events, Southern African regions typically encounter dry conditions are amplified by climate change (Huang & Stevenson, 2023). The diagram provided in figure 1 below illustrates a schematic representation of how drought propagation occurs under the influence of climate change (Wilhite, 2000). The negative impact of drought on the environment cannot be over-emphasised. It leads to desertification which in turn results in the loss of biological diversity causing harm to ecosystems and the natural world (Igamba, 2024). There are also hydrological impacts in which the natural cycle is being disrupted thereby creating a ripple effect on the environment in terms of balance and function (Rajsekhar et. al., 2015).

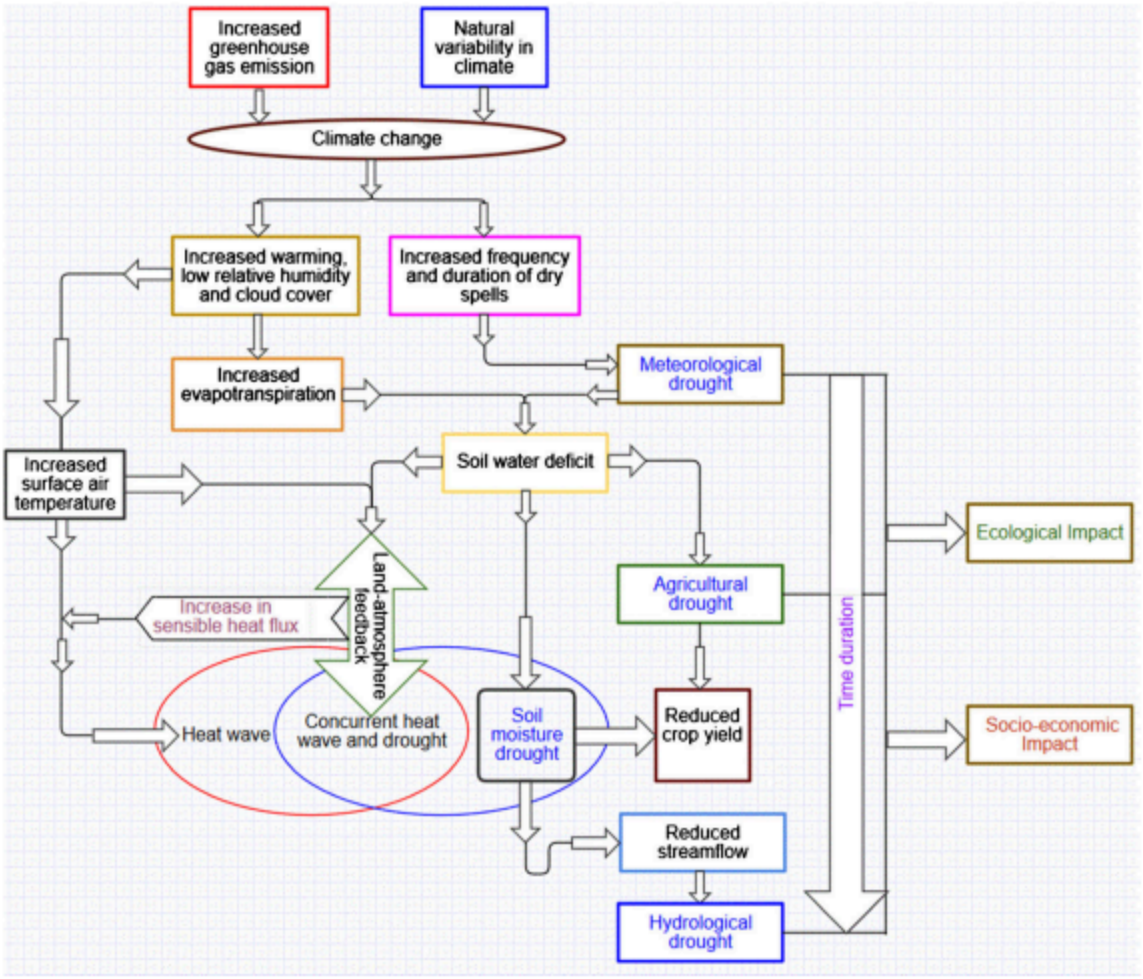


Figure 1: *Schematic draught diagram by Wilhite (2000).*

Economic Impact of climate change in southern africa

The out-fall of the extreme rainfall in economic terms is too much to negate. The result of floods on infrastructure is disastrous; the roads, the bridges, the buildings and the essential services are all in ruins (Moses et. al., 2023). In January 2020, more than a hundred homes were submerged, and fifty-six were completely destroyed in Madagascar. Also, eighty-seven schools were damaged and eleven schools were totally destroyed (Babugura, 2024). Consequently, it affects the profitable operations of the supply chains, communication networks, and the economy in general, which may necessitate millions of dollars to get the operations back on track (Davis-Reddy et. al., 2017).

Droughts also trigger substantial and irreversible social changes as a result of food insecurity. There is a profound impact on the water and agricultural sectors, leading to a significant decline in food and water security within the region. In January 2020, the World Food Programme highlighted that the prolonged drought had rendered approximately 45 million people in Southern Africa food insecure. From October 2023 to March 2024, severe temperatures and drought impacted the agricultural sector affecting food growing crops in the regions of Zambezi basin (Joint Research Centre, 2024).

There are also resultant health effects, such as malnutrition, which are common outcomes of drought exacerbated by climate change (Ahmed & Fawzi, 2021). Drought, fueled by climate change, also carries significant economic implications for affected Southern African countries (United Nations Economic Commission for Africa, 2017). Agricultural production plummets as crops fail due to lack of water, rendering the sector insignificant in contributing to the countries' economic growth (United Nations Economic Commission for Africa, 2017). This leads to food shortages and an increase in the price of food in the region (United Nations Economic Commission for Africa, 2017).

Reduced water flow in rivers cripples hydropower generation, forcing countries to rely on expensive alternatives. In 2014-2015, a drought caused a 50% decline in hydroelectric generation in Zambia, leading to a growing deficit that was challenging to handle (Simon, 2019).

Social Impact of climate change

The environmental impact of extreme rainfall is devastating floods which causes significant loss of life and destruction to infrastructural facilities (Moses et. al., 2023). According to Morake et al. (2021), the region has been subject to profoundly destructive floods that arise from mesoscale convective systems. Moreover, studies by organisations such as the World Meteorological Organisation (WMO) and the United Nations Environment Programme (UNEP) emphasise the heightened risk of floods in countries like Mozambique, Zimbabwe, and Malawi due to increased precipitation trends. These floods have led to widespread devastation, including crop damage, loss of livestock, and worsened living conditions for affected communities. In 2022, the east coast of South Africa witnessed severe flooding, which was attributed to a cut-off low weather system in a report by UNICEF (2022). Flooding also occurred in Ngamiland, Botswana in 2009,

2010, 2011, and 2017 with all events causing substantial damage (Moses et. al., 2023). Evidence of the impact can also be seen in the cases of Cyclones Idai and Kenneth, which resulted in the destruction of approximately 480 thousand hectares of crops in Mozambique. Furthermore, neighbouring countries like Malawi and Zimbabwe also experienced additional losses as a result of these cyclones (Babugura, 2024). The social impact of heavy and extreme rainfall in the region causes loss of life and displacement. For instance, there was a loss of more than 400 lives in 2022 and over 40,000 individuals were forced to be displaced from their homes (UNICEF, 2022). Floods are interconnected with bacteria, parasites, and virus outbreaks, where the drinking water is contaminated and as a result water-related diseases surge. For instance, in 2008, Mozambique witnessed the worst ever floods which brought a cholera outbreak that led to the death of 70 people. Deaths due to some diarrhoea-related diseases also occurred during that period. In addition, after Cyclone Idai in 2019, the Mozambique authorities officially declared a cholera outbreak that caused a reported 4,979 cases and six confirmed deaths.

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