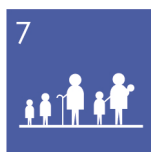


# 25. | What are the future climate scenarios in North and West Africa?

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ADVERSE DRIVERS



VULNERABILITIES

**Abstract:** This contribution shows how North and West Africa are highly exposed to climate change and threatened by extreme heat, food and water shortages. These climatic factors, in combination with other political and socioeconomic factors, will add pressure in the future to African economies and livelihoods, and may affect migration flows, often internal and to urban areas, as already observed.

Evidence that the increase of anthropogenic greenhouse gas emissions has led to significant changes in climatic conditions at the global and the local level has surged over the past two decades. Even if climate change in the twenty-first century will be limited to a global mean temperature increase of 2°C, as targeted by the Paris Agreement, the recent Intergovernmental Panel on Climate Change report (IPCC, 2018) highlights a stronger warming over land and a cascade of effects on natural and human systems, with substantial risks for impacts on ecosystems, health and agriculture. North and West Africa are among the world's most exposed regions to negative climate change impacts, due to a combination of important variability of climate, strong reliance on climate-sensitive activities, such as rain-fed agriculture, and limited economic and institutional capacity to cope with, and adapt to, climate variability and change (Roudier et al., 2011). Furthermore, under its current climate, Africa is already facing recurrent food crises, heat extremes and water scarcity, which are exacerbated by rapid population growth and unstable political environments. Climate change will thus act as an additional stress in the future of African economies and livelihood, and may affect migration flows, often to urban areas, as already observed (Waha et al., 2017).

## 25.1. Future climate scenarios in North Africa

North Africa is often considered a “climate change hotspot” (Diffenbaugh and Giorgi, 2012). Observations and model simulations concur that hot days and heat extremes have become more frequent in recent decades, while the frequency of cool days and nights has decreased (Lelieveld et al., 2016). For example, the number of warm days and nights has approximately doubled since the 1970s. This warming is absent in

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simulations over a control period without radiative forcing, and thus it can be largely attributed to human-induced climate change. Observed trends of rainfall are less homogeneous and significant, with strong declines over the Mediterranean parts of Morocco and Algeria, and parts of Libya, and a slight increase over Mediterranean Egypt.

The most important and robust change in climate projections under increased greenhouse gas forcing is the considerable change in mean, variability and extreme of temperature and rainfall (Schilling et al., 2020). Climate model projections suggest that climate warming in North Africa is much stronger in summer, which is already hot and dry (Lelieveld et al., 2016). For instance, if global warming reaches +4°C, some regions, such as Algeria, could see their mean summer temperatures increase by +8°C by the end of the century (Waha et al., 2017). In addition, a strong increase of heatwaves is consistently projected across climate models and scenarios (Lelieveld et al., 2016). In future climate scenarios, a decrease of rainfall is projected for large parts of North Africa, as well as an increase in extreme drought conditions around the Mediterranean, North Africa and the Middle East (Waha et al., 2017). Although the drying of the region is consistent between models, there is little agreement between climate models in the changes of heavy rains (Schilling et al., 2020).

The projected precipitation decreases in North Africa will affect water resources, in particular surface water that supplies the largest dams and reservoirs in North Africa (Tramblay et al., 2018). This decline in water supply is likely to occur in a region where water demand is expected to increase due to population growth and economic development, indicating higher water stress in the future (Schilling et al., 2020). The decline of water availability threatens the agriculture sector, with serious implications for farmers' livelihoods, national economies, food security and poverty. Furthermore, heat stress is recognized as the major weather-related threat for public health, increasing cardiovascular and premature mortality (Lelieveld et al., 2016), and leading to important loss of labour productivity (Dunne et al., 2013). Heat stress imposes an upper limit to adaptation to the most severe warming scenarios (Sherwood and Huber, 2010). Indeed, in the future, the climate in large parts of the Middle East and North Africa could change so drastically, with frequent hot days with daily maximum temperatures above 50°C, that it could leave part of the region uninhabitable for some species, including humans (Lelieveld et al., 2016).

## 25.2. Future climate scenarios in West Africa

West Africa is nowadays experiencing rapid climate change, depicted through widespread warming, with increasing mean and extreme temperatures in spring and summer in the Sahel (Fontaine et al., 2013; Russo et al., 2016). This observed warming is attributed to human-induced climate change, which warmed up West Africa by approximately 1°C (Sultan et al., 2019). After the long and intense drought of the 1970s and 1980s, annual rainfall is increasing in several Sahelian countries, while interannual and intraseasonal variability is very high, with frequent dry spells and heavy rains (Panthou et al., 2014). While the role of anthropic activity on the observed evolution of annual rainfall is still debated, several studies attributed the increase in the frequency of heavy rains to global warming (Sultan et al., 2019; Taylor et al., 2017).

As for North Africa, climate projections under increased greenhouse gas forcing shows a strong increase of mean, variability and extreme of temperatures. This warming is a robust feature of climate change projections, even if the amplitude, ranging between +3 and +7°C, depends on the model and the emission scenario (Monerie et al., 2012). More intense and frequent heatwaves are also expected (Vizy and Cook, 2012), and the heat stress induced by this warming is amplified by an increase of humidity over tropical and subtropical Africa, although temperature is not projected to increase as much as in North Africa (Zhao et al., 2015). The future projection in precipitation simulated by climate models in the twenty-first century is far less robust than temperature and not spatially homogeneous over the Sahel, with less rainfall expected in Western Sahel and more rainfall in Central and Eastern Sahel (Sultan and Gaetani, 2016). The occurrence of extreme heavy rains will increase over West Africa by 40–60 per cent, and the southern Sahel by 50–90 per cent during boreal summer (ibid.).

Even if the scale of the projected impacts is uncertain, a number of recent studies have estimated that increasing greenhouse gas emissions will likely reduce mean crop yields and increase year-to-year variability of crop production (Sultan and Gaetani, 2016; Sultan et al., 2014; Knox et al., 2012; Roudier et al., 2011) in several countries of West Africa that are already food-insecure today. West African river basins will likely face severe freshwater shortages, thus limiting their potential to increase agricultural productivity through the implementation of large-scale water storage and irrigation (Sylla et al., 2018). These negative impacts on agriculture and water resources are likely to occur even under the most optimistic scenarios where global warming does not exceed 1.5°C, let alone 2°C (Sylla et al., 2018; Faye et al., 2018a; Parkes et al., 2018b). As for countries in North Africa, extreme heat also poses a serious health risk that could be fatal for vulnerable groups such as children, the elderly, and low-income people.

## 25.3. Conclusions

North and West Africa are highly exposed to climate change and threatened by extreme heat, food and water shortages. These climatic factors, in combination with other political and socioeconomic factors, could add pressure that may influence migration patterns and the occurrence of conflicts.<sup>2</sup> The countries in North and West Africa stand to gain considerable benefits from global mitigation efforts implied in the low-emissions scenarios. Such global efforts would significantly reduce the severity of the projected impacts, even if adaptation will remain essential to limit the damages caused by climate warming.

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<sup>2</sup> See Bendandi, Chapter 26 of this volume.

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