African Science Frontiers Initiatives Research Journal | ASFIRJ

Received: 31 January 2025 | Revised: 13 March 2025 | Accepted: 2 May 2025 | Published: 9 May 2025

PERSPECTIVE PAPER

Climate change and its potential impact on the health and demographic profiles of Africa

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ABSTRACT

Africa is the continent most impacted by climate change, which affects people's health directly and indirectly. The effects include infectious diseases, malnutrition, food insecurity, and damage to mental health. Africa's climate has warmed more than the global average since pre-industrial times. At the same time, the rise of sea levels along African coasts is faster than the worldwide average. The main objectives of this study are to analyze how climate change is affecting the African continent and to evaluate the impact of climate change on health and demographic profile. To analyze the impact of climate change on health, a trend analysis of demographic indicators related to climate change from the World Bank and a study of the nine climate risk profiles of African countries are carried out. With differences between countries, the climate effects will be a warmer and drier continent, with an increase in extreme weather events. Impoverished rural and urban populations will be the most affected. Climate impact and its effect on health are exacerbated by the interaction between demographic growth, urbanization, and the lack of resources, which contribute to low levels of adaptation to high-intensity meteorological phenomena.

KEYWORDS:

Climate change, weather events, health, Africa, urban population, population growth, demographic indicators, climate risk

INTRODUCTION

Fast environmental changes create observable effects in multiple domains, from air quality, temperature, and weather patterns to food security and disease burden[1]. Africa contributes little to the climate crisis but suffers a disproportionate burden of severe climate change impacts, with differences between countries and geographical regions (Figure 1).

Figure 1. Map of Africa's climate disasters, 1980-2023. Resource: Alize le Roux and Jakkie Cilliers (2024), Retrieved from https://futures.issafrica.org/thematic/14-climate-change/

The EMDAT database reported that since 1980, Africa has faced 1,858 climate-related disasters. Water-related disasters are the highest climate-related incidents in Africa (82%) in the last 45 years[2,3]. Climate change in Africa is modifying the landscape of diseases, affecting both infectious and non-communicable diseases. The global temperature has risen significantly over the past 100 years. Rising temperatures, averaging 0.89 °C from 1900 to 2000[4], and alterations in rainfall patterns are projected to shift the prevalence of diseases like malaria, dengue, and measles[5]. This increase in temperature is observed in Figure 2.

Due to prolonged droughts and intense flooding, outbreaks of water-borne diseases, including cholera and diarrheal illnesses, have become more prominent in certain regions[5]. Climate change also affects respiratory health, particularly in urban areas marked by industrialization and increased transportation activity. Vulnerable population groups, such as the elderly, those with pre-existing health conditions, and children, face an elevated risk of heat-related illnesses like heatstroke[2,6].

Changes in the distribution and seasonal transmission of vector-borne diseases are among the many health implications of climate change that are anticipated[7]. Concerning malaria, a major cause of morbidity and mortality in Africa, predictions point to large negative effects due to the climate impact on the burden of the disease[8]. More than 550,000 additional malaria deaths attributable to climate change are predicted from the

year 2030 to the year 2049 based on model outputs of current intervention coverage levels[9].

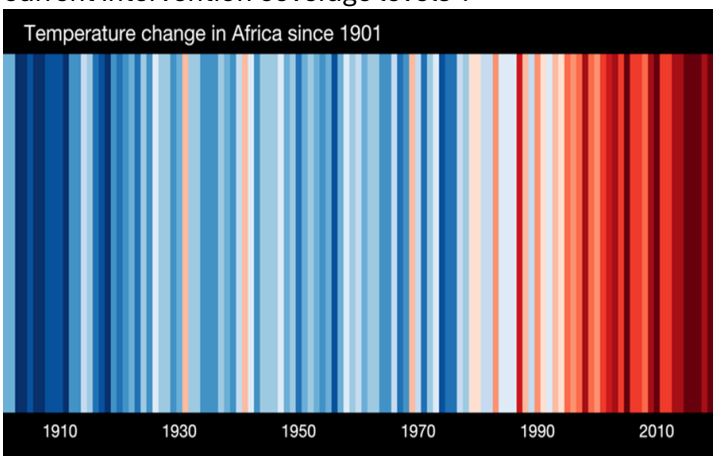

Figure 2. Temperature change in Africa 1901. Resource. Miller et al., 2020. The graphic was created by Professor Ed Hawkins (National Centre for Atmospheric Science - UoR.), retrieved from https://showyourstripes.info

Demographic indicators affect and are closely related to health conditions and vulnerability to climate change. Although demographic trends vary between countries, in 2024, Africa's demographic profile was characterized by a young population (median age 19,3 years), high fertility rates, and rapid population growth. Despite being the fastest urbanizing global region, Africa remains the least urbanized continent (45% of the population)[11].

The main aims of this study are to analyze how climate change affecting the African continent, and to evaluate the impact of climate change on health and demographic profile.

METHODS

In this perspective study, the following approach was developed to analyse the impact of climate change on health and demographic indicators, from secondary data available from credible sources, specified below. On the one hand it was carried out a trend analysis of demographic indicators related to climate change from the World Bank focused on data grouped by region: Eastern and Southern Africa, and Western and Central Africa, from the World Bank, https://databank.worldbank.org/indicator. In parallel it was carried **ou**t a case study of the nine-climate risk African countries' profiles: Cape Verde, Ethiopia, Mali, Morocco, Mozambique, Nigeria, Democratic Republic of Congo, South Africa, and South Sudan. Data from Climate Change Knowledge Portal - World Bank, https://climateknowledgeportal.worldbank.org/

For the trend analysis, the data from Eastern and Southern Africa, and Western and Central Africa, will be compared and related to those recorded for the World, Low-income countries, Lower middle-income countries, Upper middle-income countries, and the Middle East & North Africa region. The demographic indicators analysed were as follows: population growth, population ages (0-14 years), population ages (15-64 years), population ages (> 65 years), neonatal mortality, under five years mortality, dying probability (5-9 years), dying probability adolescents (10-14 years), dying probability (20-24 years), age dependency, urban population below five meters and population living in slums. For most indicators, data series from 1990 to 2022 were analysed, except for the last two indicators of the list for which the recorded data series are shorter (Supplementary Datasheet 1).

For the case study of the nine-climate risk African countries profiles, the selection of these was made of considering the representativeness of the geopolitical subregions of the continent and the different levels of vulnerability to climate change quantified by the ND_GAIN Index, selecting countries with high, moderate and low scores on this indicator out of 187 countries in 2024. Cabo Verde (ranking 80 ND-GAIN Index), Democratic Republic of Congo (DRC) (ranking 184 ND-GAIN Index), Ethiopia (ranking 155 ND-GAIN Index). Mali (ranking of 180 ND-GAIN Index), Morocco (ranking of 67 ND-GAIN Index), Nigeria (ranking 152 ND-GAIN Index), Mozambique (ranking 153 ND-GAIN Index), The Republic of South Africa (ranking 95 ND-GAIN Index), The Republic of South Sudan (ranking 183 ND-GAIN Index).

Ethical consideration

This study was carried out by the authors using open-access data, already published, by the principle of confidentiality of individual and collective data and was analyzed following the methodological principles explained in this section, giving rise to results inherent to the analysis carried out to avoid plagiarism or any other scientific misconduct.

RESULTS

Analyzing the profile of the indicators selected for this study over time, we can observe a decrease, both among geographical subregions and across the African continent and globally, in the rates of neonatal mortality, under- five- years mortality, and young age at death , being more pronounced at the global level.

Population and demographic indicators affect and are closely related to health conditions and vulnerability to climate change. Population increase negatively affects human vulnerability to extreme weather events, which magnifies the damage caused by climate change[10]. In turn, this is the continent most affected by extreme natural events. Although demographic trends vary greatly between countries, in 2024 Africa demographic profile is characterized by a young population (median age of 19,3 years), high fertility rates, and rapid population growth, the highest in the world, above 2.5% compared to the 0.7% world average in 2023 (Figure 3.A).

From the data analysis between the two African subregions, Eastern and Southern Africa and Western and Central Africa, very similar profiles were observed for most of the demographic indicators studied (Supplementary Datasheet 1). With a very young population, 41.5% of the Sub-Saharan African population is between 0-14 years old (World, 25 %), and only 3% of the population is over 65 years of age (World, 10%) (Figure 3.C-E). The age dependence ratio (81% in Sub-Saharan Africa) is elevated, reinforcing the population's vulnerability to extreme events (Figure 3.B).

The neonatal mortality and under-five years mortality ratios, despite their decrease in the last 25 years, are still elevated, mainly in Western Africa (30/1000 neonatal deaths and 92/1000 < 5 years deaths) (Figure 3.F-G). Climate changes are put in check, achieving the values set by the SDG 2030 Agenda. On the other hand, Eastern Africa presents the highest value of probability of dying among adolescents and youth aged between 20-24 years (7/1000 estimated adolescent deaths and 12/1000 estimated youth deaths). Highlight the abrupt increase of this indicator in East Africa from 1992 to 1994 ($10{,}8x10^{-3}$ to $14{,}09x10^{-3}$), declining again from 1994 to 1996 (10x10-3) (Figure 3.H). This abrupt increase and subsequent decline could be explained by strong-armed conflict in Africa; the Somali Civil War (1991), and the Rwandan genocide (1994)[12].

In most of Sub-Saharan Africa, the decline in fertility and infant and young population mortality rates, especially in Eastern and Southern Africa, compared to the end of the 20th century, has caused the population's working age to grow faster, creating opportunities to accelerate economic growth. To benefit from this "demographic dividend", governments must invest in education and health, especially for young people, and create the conditions for sustained economic growth[13,14]

Other demographic indicators analyzed; the urban population below 5 meters and the population living in slums vary by country, with the highest percentage of the population living in slums in Eastern and Southern Africa (54%), which influences the magnitude of extreme weather events (Supplementary Datasheet 1). In sub-Saharan Africa, 70 % of urban dwellers live in slums. The effects of climate change and urbanization may work synergistically to increase the disease burden[15]. The average global population in African coastal lowlands (10% of people), between 2000 and 2020, had an annual growth rate greater than 3%. Therefore, impacts of relative sea level and extreme climate events, such as flooding, disproportionately affect large coastal population centers, mostly in West Africa[16.]

All indicators present different values when compared to the North African region, being more like those observed for lower-middle-income countries and observing the pattern of low-income countries for Sub-Saharan Africa (Supplementary Datasheet 1), These observations strengthen our knowledge of the relationship between economic growth and the level of development of countries.

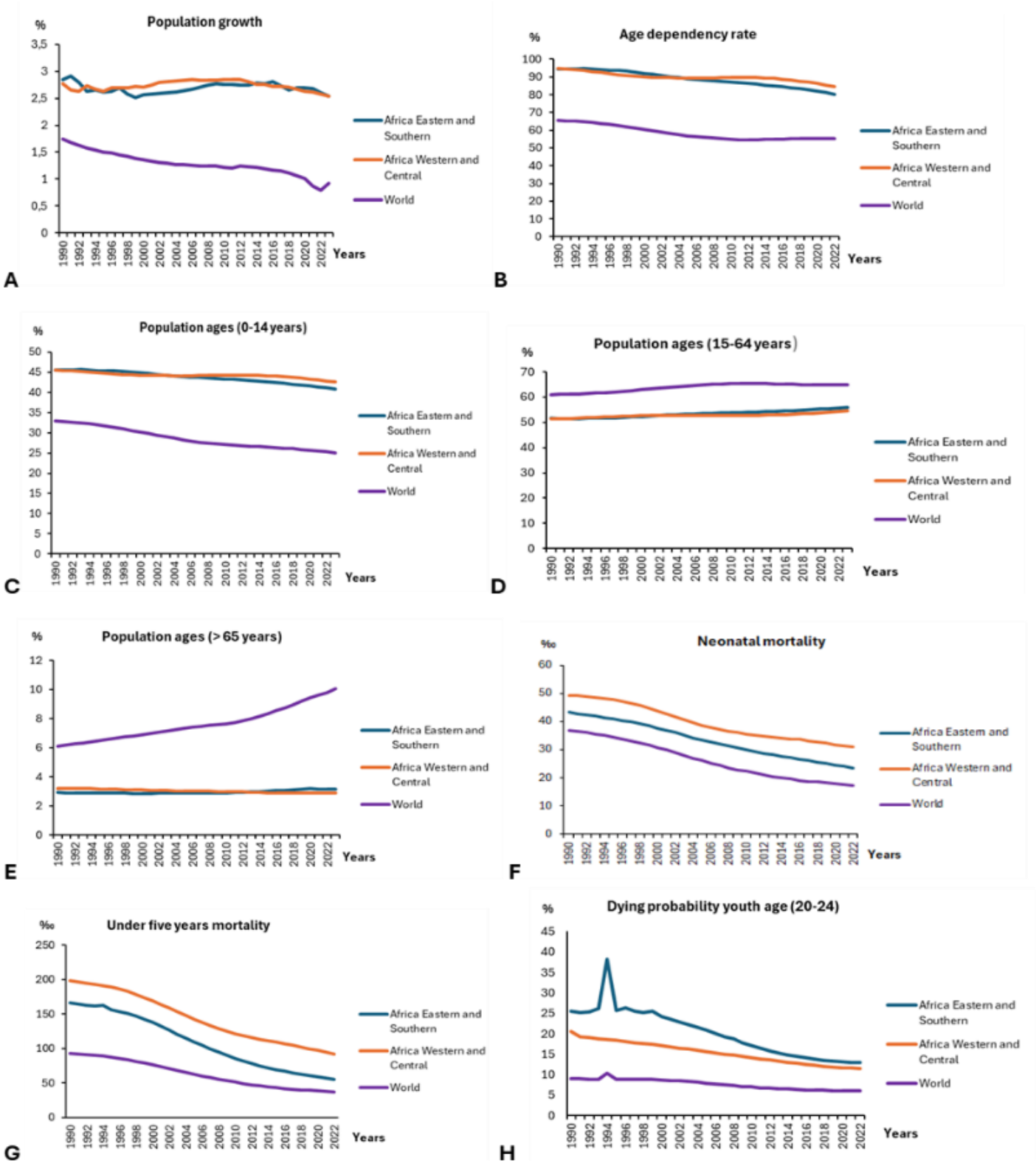

Figure 3. Demographic indicators for Africa Eastern and Southern, Africa Western and Central, and World, from 1990 to 2022 years.

DISCUSSION

Climate risk profile in nine African countries; a case study

According to the Notre Dame Global Adaptation Initiative's (ND-GAIN) Country Index updated in August 2024(https://gain.nd.edu/our-work/country-index/), which shows a country's current vulnerability to climate disruptions, 34 of 54 African countries have scored among the top 25% (highest climate risk). The five highest scores of the ND-GAIN index are found in Africa, with only Mauritius ranking among the 25% with the lowest scores (lowest vulnerability).

Main climatic observations of the study countries

The climate profile of all the countries varies, from arid and semi-arid climate zones to humid tropical and subtropical regions and savannas, through continental, Mediterranean, desert, and mountainous climates. All countries present similar patterns of modifications due to climate change; a progressive increase in temperature, and a decrease in precipitation and/or an increase in the variability and intensity of rainfall and heavy rain events (Supplementary Document 2). These patterns evidence the known global warming associated with climate change and corroborate warming at a slightly faster rate in Africa than the Global average (+0.3 °C per decade between 1991 and 2023). Three of the nine countries studied had increases in average annual temperature above this value (Mali[17], South Africa[18], and South Sudan[19]). In turn, Mali, Nigeria, and Morocco present the worst predictions concerning the increase in average temperature, with values of 5.9, 5.7, and 5 ºC more, respectively, until 2090[17],[20,21]. About the reduction of rainfall, four countries (Morocco, Nigeria, Ethiopia, and South Sudan) present projections of 20% less until 2060[19-22]. For DRC, Nigeria, Mozambique, and South Africa, climate projections point to an increase in the irregularity and intensity of heavy rain events, and for Morocco and Cabo Verde, projections point to an extension of the dry season[23-25].

Climate-related natural hazards in study countries

All the study countries are affected by droughts and floods, to varying degrees, with the latter being the primary natural hazards for the DRC[23], and droughts for Cabo Verde[25], Ethiopia[22], South Africa[26], and Morocco[21]. Natural hazards caused by soil erosion and desertification affect countries such as Cabo Verde, DRC, Ethiopia, Nigeria, Morocco, and Mali[20-25]. In coastal countries (Cabo Verde[25], Nigeria[20], Morocco[21], and Mozambique[24]), the sea-level rise has a significant impact, as they are also areas with large population centers. Higher temperatures and drier weather are responsible for wild forests, affecting countries like Cabo Verde[25], South Africa[26], and Nigeria[20]. The increase in storm-related events due to climate change, are important climate-related natural hazards in South Africa[18], Nigeria[20], and Mozambique[24]. Finally, epidemics are considered impactful natural disasters in Cabo Verde[25] and DRC[23]. The most affected populations, with differences between countries, are impoverished rural and urban populations, and/or located on the coastlines or below sea level. In some countries (DRC[23], Nigeria[20], South Africa[18], Mali[17], and Mozambique[24]), one or more of the following social factors, such as poverty, political insecurity, conflicts, and high population densities, increase their vulnerability to weather-related natural disasters. The agricultural sector is highly affected by climate change, especially in South Sudan[19], Nigeria[20], Mali[17], and Mozambique[24], with 80% of the poor population depending on this sector. Another of the main impacts due to the increase in climate-related natural hazards is food insecurity and water resources, causing malnutrition and hunger in countries such as Ethiopia[22], South Africa[18], Morocco[21], and Mali[17]. Climate modifications cause important impacts on ecosystem degradation and/or diversity in DRC[23], Ethiopia[22], Nigeria[20], and Mali[17].

Climate change impacts on the health of the study countries

Gradual climate changes that affect the quality of water, food, and air also hurt human health across the globe (World Bank Climate Change Knowledge Portal) both direct and indirect exposure. Extreme climate events have direct detrimental health impacts, whereas gradual climate change causes indirect effects on infectious, water-borne, vector-borne diseases and food security. Analyzing how climate change affects the nine study countries, it observes the following:

Climate change negatively affects malnutrition and hunger conditions, due to the increase in food

insecurity. In Nigeria, projections indicate a 20% increase in hunger and malnutrition by 2050. In countries plagued by prolonged drought, like Mali and Ethiopia, the hotter and drier climate predictions will increase severe and chronic malnutrition[22,28], mostly in children and women, causing irreversible cognitive and physical damage. In Cabo Verde, a small island development state (SIDS), with scarce areas suitable for agriculture, climate change will increase food insecurity and its effect on nutrition and health[25]. Other countries affected are South Sudan[19], Morocco[21], and RDC[23].

The rise in temperatures, floods, and variability in precipitation are responsible for the increase and expansion of vector-borne diseases, primarily malaria, dengue, and yellow fever, but also, lymphatic filariasis, and Rift Valley fever in Mali and schistosomiasis in Morocco[20]. In Ethiopia, where 70% of the population lives in malaria-endemic areas, and 20% of epidemic deaths are in children under five years, is expected that spread of malaria and dengue will increase by 2070[21]. In Mali[28], Nigeria[20], and DRC[23], where malaria is the main cause of death in children under five years, the impact of climate change can be enormous on the morbidity and mortality of this disease. Projections for the DRC indicate a tripling of malaria cases by 2050[23]. In other countries such as South Sudan and Mozambique, where malaria remains endemic and causes epidemics, an increase in cases of the disease is estimated[19,29].

Increased flooding will facilitate the spread of waterborne diseases like diarrhea and cholera, the first affecting all study countries to a lesser or greater extent. In South Sudan and Mozambique, diarrhea is one of the main causes of death, being the fifth leading cause of death (2015) and affecting mainly children under five years in the latter. In Ethiopia and Nigeria, an increase of 9.6% and 9.8%, respectively, in diarrheal deaths in children under 15 years is expected due to climate change[20,22]. In Cabo Verde, since the 1950s the country has had a 15% higher incidence of dengue, malaria, and water-borne diseases[25]. Some of the study countries suffer from cholera epidemics, the trend of adverse climatic events such as floods, and the variability of precipitation has an important impact on the increase and spread of this disease, affecting South Africa, Mozambique, and the DRC[29,30].

The impact on maternal and child health will also be affected. The effect of deficient health systems that increase vulnerability to adverse climate effects in countries such as Cabo Verde[25], South Sudan[19], Morocco1[21], Mali[28], and Mozambique[24].

Respiratory illnesses associated with air pollution will also increase due to rising temperatures and dust storms caused by climate change. Among the countries studied, some are and will be more affected, such as South Africa, Mali, and Nigeria[18,20]. In the latter, respiratory infections are responsible for 19% of deaths in the country, mainly in urban areas. In Mali, dust storms are responsible for meningococcal meningitis epidemics, mainly in children[28].

Another emerging infection that will be impacted by global warming over deforestation is the transmission of the Monkeypox virus (MPX) from wildlife to humans. In DRC, climate projections show MPX's range shift into regions where MPX has not been recorded previously, including increased suitability in eastern parts of the country[23].

Finally, all the countries are impacted by stressful weather events, which cause direct injuries and deaths in the population, mainly among the most vulnerable. Morocco, Nigeria, South Africa, and Ethiopia[22] are affected by deaths and heat-related medical conditions. In South Africa, there have been increased deaths and post-traumatic effects due to extreme temperatures in the elderly[18]. In Nigeria, projections point to an increase in heat-related deaths in the elderly (80/100,000) up to 2080, relative to the average of (3/100,000), in 1960-90[20]. In Morocco, many people are at risk of heat-related medical conditions[21].

CONCLUSION

From the results obtained from the case study of the nine-climate risk African countries' profiles, it is concluded that climate change and its health impact are relevant challenges Africa faces. Regions will be affected differently, but the general trend would be for a warmer and drier continent, with some countries affected more profoundly than others.

Attributing extreme weather events to a specific cause is not straightforward because they can be caused by natural variability in climate systems, anthropogenic activity, or a complex interplay between both. Africa is vulnerable to climate change due to other non-climatic factors, such as poverty, hunger, conflict, and low levels of development.

Many African communities are vulnerable to the impacts of extreme weather events because of their limited ability to cope and adapt to those events. This is exacerbated by an interplay between population growth, urbanization, and lack of access to information and resources (including economics), contributing to low adaptation levels for high-intensity weather events.

Based on the trend analysis of demographic indicators related to climate change from the World Bank, data show a trend toward a positive demographic transition, with declining mortality rates, population growth above the fertility rate, and a high working-age population. Although the age dependency rate is high, predictions point to a 1.7:1 ratio of working-age people to dependents by 2050, an ideal level at which the demographic dividend favours economic growth[31].

Demographic resilience is a key aspect of overcoming African demographic and climate challenges. Thus, adopting a regional ecosystem-based adaptation approach can be a flexible and cost-effective strategy to address food security issues and better living conditions. Combating climate change in Africa and its health effects includes investing in early warning systems, developing sustainable energy sources, reducing-impact forestry, climate-smart agriculture, and improving infrastructure[32].

CONFLICT OF INTEREST

The authors declare that the research was conducted without any commercial or financial relationships that could be construed as a potential conflict of interest.

AUTHORS' CONTRIBUTIONS

LG contributed to the conception and design of the study, and approved the final manuscript, LG and IB wrote the manuscript, and all authors contributed to revising the manuscript.

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