

Climate Change-Related Disaster Risk Events in Togo: A Systematic Review

Massama-Esso P. Assiah^{1*}, Gouvidé Jean Gbaguidi¹, Mouhamed Idrissou^{1,2}, Kossivi Hounake³

¹West African Science Service Centre on Climate Change and Adapted Land Use (WASCAL), Department of Geography, Faculty of Human and Social Sciences, Université de Lomé, Lomé, Togo

²École Polytechnique de Lomé, Université de Lomé, Lomé, Togo

³Faculté de Droit, Université de Lomé, Lomé, Togo

Email: *welcomeassiah@gmail.com

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Abstract

Togo is facing significant climate challenges that have profound consequences for its environment, economy, and population. This study provides an overview of various climate phenomena affecting Togo and highlights potential adaptation strategies. We used the inclusion and exclusion criteria (PRISMA) to search both French and English articles on climate change-related disaster risk events in Togo through Google Scholar, Directory of Open Access Journals (DOAJ), and PubMed databases using the keywords “Climate Change”, “Floods”, “Drought”, “Coastal erosion”, “High winds”, “Epidemy”, “Heatwaves”, and “Air pollution”. Twenty-five articles from 2000-2023 were included in this study after applying different criteria. Droughts, floods, coastal erosion, food and crop productivity loss, heatwaves, spread of vector-borne diseases, air pollution, and high winds are among the climate phenomena discussed. These challenges are driven by climate change, altering precipitation patterns, increasing temperatures, and rising sea levels. Drought, floods, coastal erosion, loss of food and crop productivity, spread of vector-borne diseases, air pollution and heatwaves are the most climate risks experienced by Togo. Drought contributes to decreased plant cover, water scarcity, and changes in the water and energy balance. Floods cause property damage, health risks, and disruptions to livelihoods. Coastal erosion threatens coastal communities, infrastructure, and ecosystems. Adaptation strategies include early warning systems, improved water management, sustainable agriculture, urban and health planning, and greenhouse gas emissions reduction. Drought-resistant crops, mosquito control, and clean energy adoption are essential.

Keywords

Disaster, Risks, Impacts, Climate Change, Vulnerability, Togo

1. Introduction

Climate change and global warming are global concerns that have been attracting the attention of the international community for decades (Akpodigaga-a & Odjugo, 2010). The increase in global temperatures has resulted in the melting of glaciers, rising sea levels, and shoreline regression, affecting human habitat and infrastructure, as seen in Togo (World Bank, 2023). Togo's National Adaptation Plan of Action (NAPA) recognises the vulnerability of different regions, social groups, and key sectors to climate change, including agriculture, water resources, coastal areas, human settlements, and health. Togo is exposed to various climate risks, including floods, droughts, extreme heat, delayed seasons, strong winds, uneven rainfall distribution, and coastal erosion. Coastal erosion in Togo is closely related to the Akossombo dam and the Lomé harbour, which trap sediments and prevent their east side from getting much sediment (Ministere de l'Environnement et des Ressources Forestieres, 2009).

The United Nations Framework Convention on Climate Change continues to encourage countries to develop their national communications on the geographical and socio-economic facts recorded, foreseeable, and predictable from climate variations on short-term or long-term scales (Kundzewicz et al., 2014). In this respect, Togo is also pragmatic, like other developing and vulnerable countries, by proposing, in 2001, its Initial National Communication on Climate Change in accordance with the provisions of Articles 4 and 12 of the Convention. It identified the main development parameters and factors that could influence climate or be affected by the effects of climate change, as well as forecasts of development sectors over varying time scales. The second national communication was therefore produced in 2010.

The reduction of the risks of disasters and threats appears today as a necessity for sustainable development (Chang & Franczyk, 2008; Bronstert, 2003). Over the past two decades, Togo has experienced an upsurge in disaster events and threats related to climate change (Pilo, 2016; Mikémina, 2013), with loss of life as well as considerable socio-economic and environmental impacts (Ali, 2018; Sokemawu, 2017). Among the risks related to climate change in Togo, we can mention flooding, drought, strong winds, and coastal erosion (Koudahe, 2016; World Bank, 2023).

One is still pushed by research to take into account the strong enough realities of climate change through the continuous increase in temperature, as the data of scenarios built based on several cross-references show alarming situations in the near and far future (Ziervogel et al., 2014). The planet will experience a temperature increase of 2°C from 2035 onwards; this will bring about heat waves, known phenomena with intensified behaviour, and extremely difficult relationships between humans and their environments (World Bank, 2023).

The historical change in climate in Togo has shown effects on both the socio-economic and natural systems (Guerrera et al., 2021). The sectors affected include water resources, agriculture, pastoralism, coastal areas, fishing, human set-

tlements and health, and energy (Cissé et al., 2011; Sanou & Badolo, 2017). Identifying the different disaster risks that affect Togo and assessing the governance or management of these risks can help reduce climate change's impacts on humans and ecosystems.

The current systematic literature highlights the various climate risks facing Togo, including drought, flooding, coastal erosion, high winds, epidemics, air pollution, food and crop productivity loss, and their impacts on the environment, socioeconomic aspects, and cultural aspects.

2. Study Area

The Republic of Togo is situated in West Africa, along the Gulf of Guinea, encompassing latitudes 6°N to 11°N (Figure 1). It shares borders with Ghana to the west, Benin to the east, and Burkina Faso to the north (World Bank, 2023). The southern coastline spans 56 kilometres (km) and lies on the Gulf of Guinea.

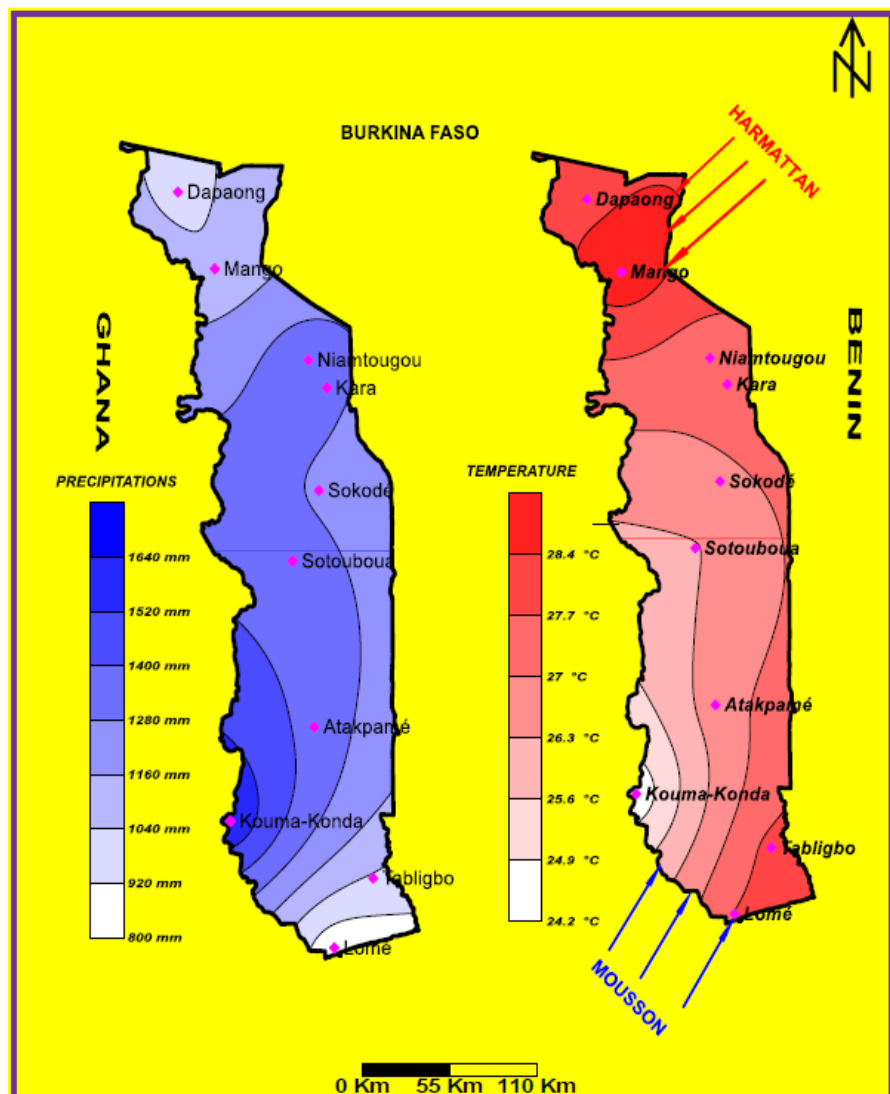


Figure 1. Study area and Climatic map (ANPC, 2020).

Covering an area of 54,600 km², the country features diverse geographical characteristics, including rolling hills in the north, a southern plateau, and a low coastal plain with extensive lagoons and marshes. Togo's population faces significant challenges, with approximately 69% of rural households currently living below the poverty line. The country's climate varies from tropical to savanna. The southern region experiences high humidity, with an average annual temperature of 27°C. In the north, temperature fluctuations are more pronounced, ranging between 17°C and 41°C. Rainfall patterns in the southern part of the country follow two distinct seasons: the first occurring from mid-March to late July, and the second from early September to early to mid-November. The dry desert winds known as the Harmattan blow from the northeast, bringing cool and dry weather between November and March. Periodic droughts also affect the northern regions (ANPC, 2020).

Togo's poverty levels and reliance on rain-fed agriculture and livestock leave it particularly vulnerable to climate change. This vulnerability limits the capacity of poor households and communities to manage climate risks, increasing their susceptibility to climate-related shocks. The country is projected to face an increase in weather-related hazards as a result of climate change. Sectors such as agriculture, energy, health, housing, water resources, and coastal areas are expected to be particularly vulnerable to these climatic changes. Coastal erosion is a pressing concern, as it may worsen with future climate change, leading to the loss of valuable goods and services. Notably, more than 90% of the country's industrial units are located in coastal areas, amplifying the potential impact of such changes.

Togo is classified into five (5) ecological zones. The northern plains are dominated by dry forests and dry savannas, whereas the northern branch of the Togo Mountains is largely covered by clear forests, diversified savannas, forested gorges, and dense woods. The third zone is the central plain, which is characterised by dry forests and dry savannas distinguished by trees and bushes. Zone IV is the southern branch of the Togo Mountains, which is covered in true evergreen woods. Last but not least, Zone V is associated with the coast (ANPC, 2020).

Overview of the current climatic risk events in Togo

Figure 2 displays the climate risks in Togo. The analysis of this figure reveals that drought takes the lead with 88.1%. It is followed by strong winds (79.2%), vegetation and forest fires, and then floods, all at a rate of 77.2%. In the upcoming ten (10) years, considering the current climate changes, it will be challenging to significantly reduce the impact of these major climate threats on humans and their environment. They will occur more prominently and increasingly affect the Togolese population (Togolaise, 2021).

3. Methodology

We conducted a thorough review of the literature to search for relevant articles

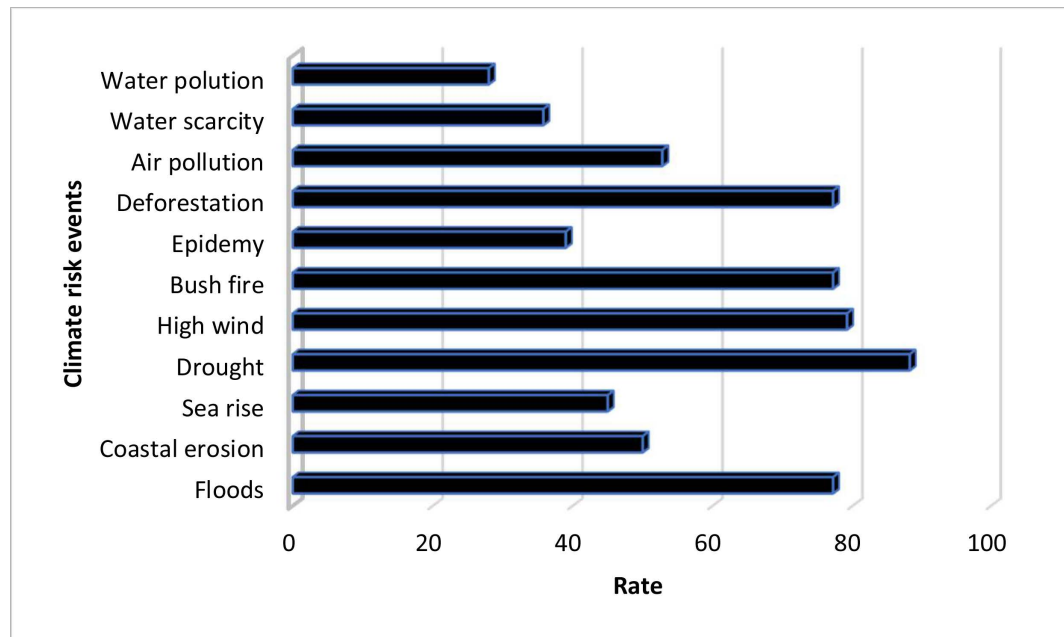


Figure 2. Climate risks in Togo (Togolaise, 2021).

related to climate change-related disaster risk events in Togo. We used the inclusion and exclusion criteria “Preferred Reporting Items for Systematic Reviews and Meta-Analyses” (PRISMA) to search both French and English articles on climate change-related disaster risk events in Togo through Google Scholar, the Directory of Open Access Journals (DOAJ), and PubMed databases using the keywords “Climate Change”, “Floods”, “Drought”, “Coastal erosion”, “High winds”, “Epidemy”, “Heatwaves”, and “Air pollution”. Only studies that were released between 2000 and 2023 were included in our analyses (Figure 3).

We found in the three databases 52 articles related to our topic. After inclusion and exclusion criteria, 35 articles were selected from the three databases. To establish whether they were going to be included in the second step, all titles and abstracts were first read. Once a candidate was chosen, the inclusion and exclusion criteria were applied in their entirety to make the decision.

Drought

The possible effects of decreasing trends in yearly precipitation on numerous climatic variables have been noted in several studies. According to (Djaman et al., 2017), these decreases in precipitation may cause periodic droughts, a decrease in plant cover, an increase in evapotranspiration, changes in surface albedo, and consequences for the water and energy balance. In southern Togo, a strong warming trend in T_{min} and T_{max} could have a detrimental effect on crop production (Koudahe, 2016). A rise in high temperatures across the Mono Basin, which would exacerbate the consequences of droughts, was predicted by (Emmanuel et al., 2019).

Additionally, because of high temperature and precipitation variability, the Plateaux, Maritime, and Savanes regions of Togo are more exposed to climate change and variability (Pilo, 2016). Extreme maximum temperatures have

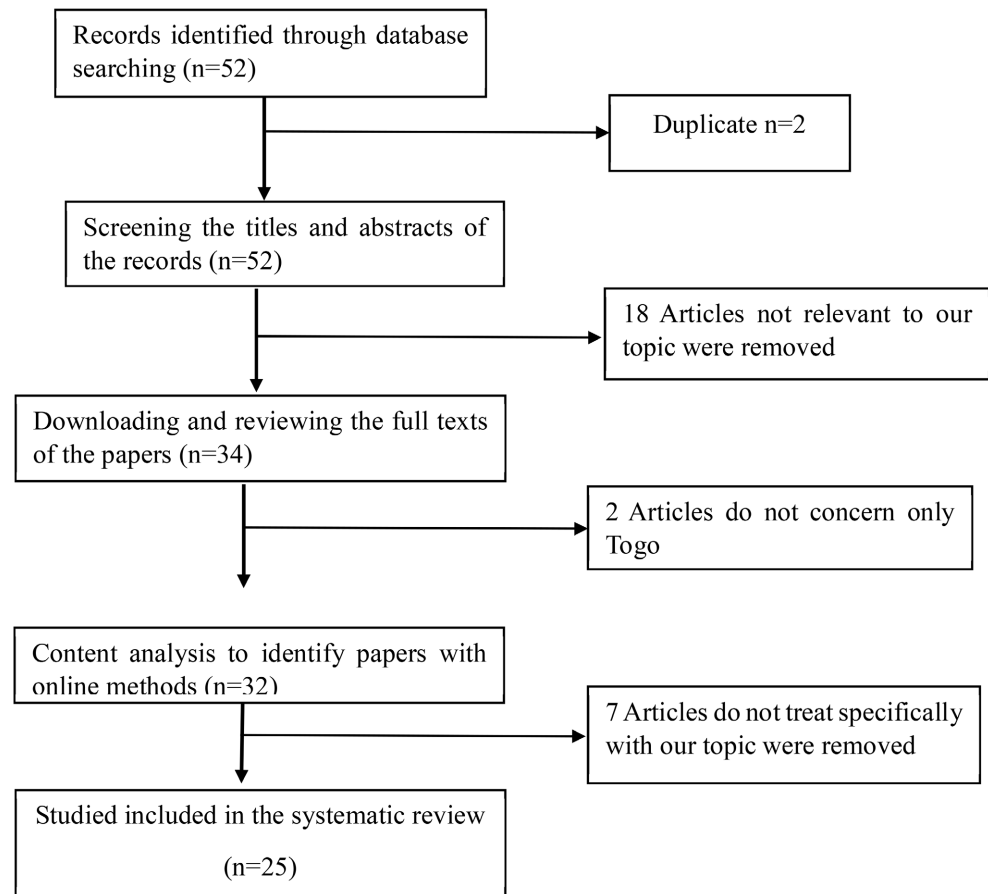


Figure 3. The PRISMA inclusion and exclusion criteria of the selection.

been observed (Künzler, 2012). The management of water resources, particularly in rural and urban agricultural zones, could be severely impacted by patterns in annual precipitation that are on the decline. Recurrent droughts, decreased plant cover, increased evapotranspiration, changes in surface albedo, and implications on the water and energy balance are a few potential effects of these trends. Some parts of Togo are more exposed to climate change and fluctuation, which exacerbates the consequences of droughts.

Floods

Floods are natural disasters that can have severe consequences on human health, the environment, and the economy. Globally, the frequency and severity of flooding disasters have increased as a result of human activity and changing climatic patterns (Lamboni et al., 2020). A higher frequency of flooding events has been linked to altered rainfall patterns and rising temperatures in Togo, according to studies (Cissé et al., 2011). Floods are the extreme climate event that receives the greatest attention.

Flooding also presents several health dangers, such as waterborne disease and the deterioration of sanitation systems in the lower lands, such as the lower Zio Valley. To promote better sanitation, offer medical and psychosocial treatment, and repair damaged health infrastructure, health authorities and humanitarian

organisations must coordinate their efforts (Sokemawu, 2017).

While changes in land use have not greatly increased runoff, studies have found a correlation between extreme daily rainfall and maximum daily flow rates (Koungbanane & Totin Vodounon, 2021). In contrast, settlement at riverbanks has increased exposure and flood risk. Different rainfall patterns are experienced in the Mono River basin. A permanent flow downstream has resulted from the construction of the hydroelectric dam, helping agricultural industries.

Additionally, an assessment of the flood risk at the lower end of the Mono River Basin showed that some settlements are more vulnerable to flooding because of their lower elevation and the ineffective regulation of the Nangbeto dam (Ntajal et al., 2017). Land use changes, urbanisation, and population growth have had significant impacts on the environment and natural resources in the basin (Expédit Evariste et al., 2005). According to Ali, flooding incidents reduce corn yield. To mitigate risks and get ready for the probable effects of flood disasters, risk assessment and territorial planning are essential (Ali, 2018).

Coastal erosion

Coastal erosion and sea level rise are significant issues globally, with severe implications for human settlements, infrastructure, and the environment. In Togo, coastal erosion due to human activities and climate change is a growing concern, with the most affected cities being Aneho and Lomé. The establishment of Lomé's autonomous deep-sea port in 1968 accelerated coastal erosion and resulted in the disappearance of beaches. The average rate of erosion is close to 3 metres per year (World Bank, 2023). Residents of Togo's coastal regions have also noticed a rise in ferocious sea waves, erosion, rising sea levels, and environmental changes brought on by climate change (Bankati & Napo, 2022).

The vulnerability of the Togo margin is linked to incoherent lithofacies, vertical motions, and a low-angle beach profile. Climate change and sea level rise all contribute to erosion. Factors such as direct wave action, coastal currents, tide excursions, and tidal currents further exacerbate erosion (Guerrera et al., 2021). Furthermore, erosion is also made worse by direct wave action, coastal currents, tide excursions, and tidal currents (Guerrera et al., 2021).

Human activities and climate change exacerbate coastal erosion in Togo, with severe implications for human settlements, infrastructure, and the environment (Le Dissez, 2015). The vulnerability of communities to these effects is a daily concern, and adaptation is difficult due to the costs involved. Strategies used to enhance coastal management efforts include monitoring and evaluation programmes and the development of an early warning system.

Food and crop productivity loss

Climate change is a major factor in low yields, a lack of rainfall, and the collapse of riverbeds, all of which contribute to a considerable loss in food production and crop productivity in Togo (Bankati & Napo, 2022).

Togo's agriculture is susceptible to climate threats such as coastal erosion, floods, droughts, scorching heat, delayed seasons, strong winds, and uneven

rainfall distribution (Pilo, 2016; Mikémina, 2013). The effects of climate change on agriculture are detrimental to farmers' income per acre as a result of decreased rainfall.

Furthermore, different crops are affected differently by climate change (Emmanuel et al., 2019). Cereal crops like maize and sorghum are highly vulnerable to water stress, resulting in decreased productivity and food supply. Climate change also affects coffee and cocoa zones, leading to increased pests and diseases (Künzler, 2012). Moreover, intra-seasonal temperature negatively affects maize yields (Koudahe, 2016), while inter-seasonal precipitation variability reduces the yield of all three crops.

Potential adaptation strategies include targeting more drought-resistant crop varieties and technologies, incorporating climate impacts into development strategies and decision-making processes, and raising awareness and adopting adaptation techniques and strategies among farmers (Kissi et al., 2023). However, the low level of adaptation among farmers, especially in the Savanes and Maritime region, indicates the need for urgent action to improve their capacity to adapt and positively affect crop production (Soviadan, 2016; Sanou & Badolo, 2017).

Climate change has significant negative impacts on food and crop productivity in Togo, with small-scale farmers being particularly vulnerable (Gadedjisso-Tossou et al., 2021). Different crops are affected differently by climate change, highlighting the need for targeted adaptation strategies (Pilo, 2016).

Heatwaves and heat-related health impacts

In Togo, concerns about heatwaves and heat-related health effects are growing as rising temperatures exacerbate pre-existing medical issues and raise the possibility of contracting infections spread by insects.

Heat waves in Togo have a major negative influence on people's health, putting disadvantaged populations in particular danger. Floods can destroy low-lying settlements, resulting in property damage and human casualties (Künzler, 2012). Frequent flooding and intense heat increase the risk of infectious diseases such as malaria, cholera, and respiratory illnesses. Climate change makes pre-existing health issues worse and raises the risk of vector-borne infections, according to Künzler (2012).

Moreover, the increase in temperature and decrease in rainfall will also affect the biological balance between crop pests and their natural predators, making the natural control of parasitic or infectious diseases less effective. However, the extreme northeastern part of the country may experience an increased proliferation of infectious diseases (Ministere de l'Environnement et des Ressources Forestieres, 2009).

To address these issues, potential adaptation measures include bettering urban and health planning, saving water, and enhancing agricultural productivity and food distribution (Agbewornu, 2018). However, affluent nations, which historically account for the majority of global warming emissions, should share responsibility for tackling these challenges. Urgent measures are needed to limit

risks and alleviate the suffering of affected communities, highlighting the need for policymakers to develop effective strategies to mitigate the impacts of heat waves on human health in Togo.

Epidemy (Spread of vector-borne diseases)

The spread of vector-borne diseases is a growing concern in Togo, with climate change exacerbating the risk of transmission. Togo is experiencing a major influence from climate change on the development of vector-borne diseases, with vulnerable groups, particularly in danger. Due to the ideal conditions for mosquito vectors and snail intermediate hosts, water-related diseases like malaria and schistosomiasis are more likely to arise in places near water networks in Togo. Six billion people will be at risk of contracting one or more diseases linked to the environment by 2050 (Cissé et al., 2011).

The seasonality of malaria cases in Togo increases during or after the rainy season and is more intense in the northern health districts, especially in children under 5 years old (Expédit Evariste et al., 2005; Agbossou et al., 2022). Factors like rainfall, temperature, and topography should be considered in malaria control activities when analysing malaria seasonality (Thomas et al., 2021). Potential adaptation strategies include improving water-related issues, such as sanitation and hygiene standards, and implementing mosquito control measures.

Air pollution and respiratory health impacts

Air pollution has significant impacts on respiratory health in Togo, with vulnerable communities being particularly at risk (Sinam et al., 2022). An assessment estimates that Togo emitted 21 million tonnes of GHG emissions in 2018, with projections indicating a 42% increase to 30 million tonnes in 2030 without mitigation policies and measures (Agbossou et al., 2022). These emissions contribute to air pollution, which can have significant impacts on respiratory health.

Potential adaptation strategies include implementing mitigation policies and measures to reduce greenhouse gas emissions, promoting sustainable transportation options, and implementing clean energy sources. However, the responsibility for addressing these issues should be shared by developed countries, which have a historical responsibility for most global warming emissions.

High winds

Strong winds are a serious natural danger in Togo, particularly for vulnerable communities. The Savanes, Kara, and Plateaux-Est regions frequently see violent winds with speeds between 100 and 115 km/h (Künzler, 2012). These winds destroy everything in their path, including crops, food, biodiversity, and soil. Winds are a significant natural hazard in Togo. As a concrete example, the prefecture of Tchamba was hit by high winds that destroyed houses and ravaged plantations on June 16 and 17, 2020, while in March 2021, a high wind destroyed clairvoyance practices in Lomé, even diverting some ships along the coast (Togolaise, 2021).

Urgent measures are needed to limit risks and alleviate the suffering of affected communities, highlighting the need for policymakers to develop effective strategies to mitigate the impacts of high winds in Togo.

4. Conclusion

In summary, several disaster risks, including drought, floods, coastal erosion, loss of food and crop productivity, the spread of vector-borne diseases, air pollution, and heatwaves, are the most experienced in Togo. The country is dealing with several climate issues that pose serious hazards to the economy, the environment, and human health. Due to the declining precipitation trends brought on by climate change, there are now more frequent droughts, fewer plants, more evapotranspiration, and changes in surface albedo. Flooding occurrences have become more frequent and severe, which harms human settlements and health. Human activity and rising sea levels are speeding up coastal erosion, endangering infrastructure and populations. Climate change has detrimental effects.

It is essential to put adaptation methods and policies into place to address these issues. This entails creating early warning systems, upgrading agriculture and water management methods, increasing the resilience of vulnerable communities, improving urban and health planning, and improving sustainable energy sources. The population must be protected, and the effects of climate change must be minimised through international cooperation and shared responsibility.

For better adaptation to present and future climate risks, it is necessary to develop strategies at both local and national levels. At the community level, reinforcing the already-implemented adaptation strategies is crucial to coping with current and future climate risks. The government should promote crop diversification, the dissemination and use of improved seeds, the adoption of short-cycle varieties, adjustments to the agricultural calendar, weather forecasting, the establishment of alert systems, the sharing of agricultural meteorological information, the construction of dikes or drains, hydro-agricultural development (including drainage systems and irrigation), reforestation, and training in agroforestry and composting techniques. To ensure effective management and prevention of health risks, early warning systems should be implemented, integrating climatic parameters. There is a need to raise awareness about vector control measures. Regular monitoring of regulations concerning drinking water and food hygiene is essential to mitigating waterborne and vector-borne diseases. Furthermore, promoting education and investing in research and development on climate-related health risks are crucial steps to take.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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