

Article

Climate change in the Greater Lomé health region: Perceptions of impacts on health systems

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Abstract: Climate change is occurring more quickly and has more complex effects than expected. The well-being of populations in general and financial resources have been impacted by climate change in recent years. Children, pregnant women and the elderly bear the brunt of the impacts caused by climate-related risks. This research aims to assess the perceptions of health personnel and clients on climate change as well as these impacts in the Greater Lomé health region in Togo. Furthermore, this research examines the differences between the perceptions of caregivers, patients and scientific observations in this area. Based on field observations, an interview guide and a questionnaire, the information collected shows that nearly 75.95% of those questioned perceived climate change, particularly in the form of an increase in precipitation concentrated on a cost duration causing floods and the scarcity of rain at the end of the year leading to droughts. More than 25.40% and 61.86% respectively perceive that droughts and floods impact their livelihoods, but do not fully understand the causes. The results are useful for planning useful actions to facilitate the management of climate-related risks in health establishments in the Greater Lomé health region. It is therefore important to carry out awareness campaigns, train stakeholders and take necessary measures to make health systems resilient.

Keywords: climatic effects; Greater Lomé; perceptions; health facilities

1. Introduction

Climate change represents the greatest threat to human health in the 21st century (WHO, 2004). Risks to health and health systems will increase. The influence of man on the planet's climate system is clearly established and remarkable by the increase in temperatures, the rise in ocean levels, the trend in precipitation and certain extreme events favoring the increase in risks for the health. Climate change has direct and indirect effects on health and well-being. These effects have impacts on health such as mental illnesses, undernutrition, allergies, cardiovascular diseases, infectious and respiratory diseases. Climate change is an important determinant of health because it can act on health systems by making health care vulnerable, impact the health of patients and staff and damage health infrastructure.

Globally, climate change is influencing public health care (Abdullah et al., 2017; Dritsaki et al., 2024). However, the climatic consequences on the well-being of populations vary from one region to another and due to a lack of resources to prepare to face these changes (Opoku et al., 2021). People living in precarious situations suffer the consequences of climate change depending on the degree of their precariousness.

(Khine et al., 2023). Although richer countries emit more greenhouse gases than less rich countries, the climate consequences are more serious in less rich countries due to limited resources such as sub-Saharan Africa (Muleia et al., 2024). Climate variability is now accepted and manifests itself quickly (Alassani, 2023; Kevin, 2023). Scientific research results indicate that climate variations lead to risks such as droughts, floods and coastal erosion (Houghton et al., 2001). These events can negatively affect elements of human systems. Indeed, climate change is the cause of several health problems around the world and particularly in developing cities where the population faces a lack of health infrastructure and financial difficulties. Climate change is seriously altering people's living conditions, but also affecting many aspects of their lives and even threatening their survival. One of the characteristics common to all countries is the increase in climate risks in recent years.

Current evidence is convincing that droughts and floods will be more severe in the 21st century due to decreased precipitation and/or increased evapotranspiration and high concentration of short-duration precipitation in some regions. Heavy rains can cause soil erosion in some regions of the world due to rising sea levels. The regularity of rains and their concentration could cause flooding and reduce exploitable land (Houghton et al., 2001). They are the cause of the outbreak of various diseases, namely malaria, diarrhea, cholera, meningitis, cardiovascular and cerebrovascular diseases, acute bronchitis, pneumonia, asthma and bronchiolitis. Healthcare staff and clients are in direct contact with their environment and have developed an intimate and intuitive understanding of what surrounds them. Local perceptions of climate change arise from habitual relationships with the environment and submission to climatic phenomena to provide health services and livelihoods in accordance with Rubin (1998). Perceptions of healthcare staff and clients may reflect local issues according to Danielsen et al. (2005).

In addition, the analyzes show that people's well-being is influenced by climate variability and its consequences, particularly for local factors that cannot simply be measured using models.

This research aims to analyze the points of view health staff and clients regarding climate change and its consequences in the Greater Lomé health region. Also, the analysis of the results showed an acceleration in the magnitude and frequency

Rains as well as recurrent flooding in this region. A difference between local opinions and the assessments highlighted the need to raise awareness among leaders and the community about the risk of flooding according to Hung et al. (2012).

Likewise, the work of Bradford et al. (2012) led to the same results. This made it possible to identify problems related to public awareness points of view in the management of flooding problems and to formulate recommendations to improve the social situation. Togo is experiencing endemic epidemics and an acceleration of certain diseases. A large proportion of hospital visits among children under 5 years of age are linked to malaria and acute respiratory infections. The number of cases of cerebrospinal meningitis has risen irregularly. Recent data from studies carried out by the Preventive Medicine Agency have indicated an increase in pneumococcal meningitis. Similarly, Togo has faced 3 meningitis epidemics from 2016 to the present, with 2416 cases and 42 deaths in total. Cholera is progressing in an endemo-epidemic manner in the Greater Lomé health region. In 2020, 68 cases including 02 deaths were

recorded in the Greater Lomé health region. The recent cholera epidemic dates from 2023 with 1 case recorded in the Greater Lomé health region.

The study of local perceptions and the gaps between perceptions and observations shows us that floods are at the origin of the proliferation of mosquito larval breeding grounds, pollution of groundwater, anarchic creation of wild dumps, proliferation of insects and other vectors, dissemination pathogenic germs. These health problems cause risks of diseases such as diarrheal diseases (cholera, amoebic dysentery, salmonellosis, etc.), dengue fever, malaria, dermatoses, typhoid fever, physical and psychological trauma, acute respiratory infections, polioviruses. The study of local perceptions and the gaps between perceptions and observations proves to be very relevant for risk management and decision-making. Carbon monoxide is a gas that is toxic to health and comes from heating or cooking appliances that run on gas, wood, coal, gasoline, fuel oil or ethanol. Once in the atmosphere, it transforms into carbon dioxide (CO₂), a major greenhouse gas, contributing to increased health risks linked to climate change. Although several studies have been carried out on the relationship between health expenditures associated with carbon monoxide emissions (Dritsaki et al., 2024), very few studies have been carried out to understand the perceptions of health personnel and clients on the impacts of these emissions on health systems.

It is with this in mind that we wondered what the perceptions of clients and staff of health establishments in this health region of Greater Lomé might be. So to answer this question we decided to carry out this study whose theme is: “Climate changes in the health region of Grand Lomé: perceptions of the impacts on health systems”.

This study aims to identify the perceptions of healthcare personnel and clients regarding climate change and the dangers associated with it. We will examine the differences between field experiences (health care staff and client perceptions) and scientific observations of climate change and associated hazards by comparing available physical data sets or their derivatives (scientific literature).

2. Materials and methods

The data was collected from primary and secondary sources. Qualitative (field observation) and quantitative (questionnaire survey of health personnel and clients) participatory approaches which were frequently used in previous perception studies as mentioned by Manandhar et al. (2011) and Sudmeier-Rieux et al. (2012) were used for primary data collection in July 2022. The questionnaire was designed with three sections (general information, perceptions about climate change and perceptions of climate-related hazards) with 48 open and closed questions based on previous studies indicated by Deng et al. (2012) and Manandhar et al. (2013). We surveyed healthcare workers aged 35 and over and clients aged 18 and over. The age criterion was used because young respondents would not have enough years of experience to distinguish climate change, indicated the DGMN (2023). And for health personnel, depending on years of experience in the work sector. In total, 112 people were interviewed out of the 162 planned. We used the formula from Gautam et al. (2001) with a degree of certainty of 90% to carry out our sampling. All respondents were able to express themselves well in the Togolese mother tongue and/or in French. Several other health personnel and clients outside the sample were interviewed to compensate if certain

data would not be usable due to non-response from certain respondents. Each interview lasted approximately 40 to 40 min. Data from scientific assessments and the documentary review were received from the National Directorate of Meteorology, the Directorate of the Environment of the University of Lomé and the Ministry of Health and Public Hygiene. The precipitation data was reported to the Lomé station and was collected from the data archives of the General Directorate of National Meteorology. We used Microsoft Excel-2010 to enter the collected information and IBM SPSS Statistics 21 software to analyze it. Based on the listwise elimination method (Acock, 2005), we managed missing data. Fisher's exact and multinomial logistic regression tests were performed apart from descriptive statistics. Past research has presented the characteristics of respondents, and the climate influenced the perception regarding climate change and the dangers associated with it, indicated the DGMN (2023) and Raymond and Spoehr (2013). For example, people who have a high intellectual level have the ability to analyze different types of climate risks (Habiba et al., 2012), and people who perceive an increase in precipitation and its instability are more informed about climate-related risks according to Manandhar et al. (2013) and Combest-Friedman et al. (2012). The responses of those surveyed were compared with the results of the analysis of climate data in order to examine the differences between field experience and scientific assessments of the changing climate and the associated risks. Our study area is the Grand-Lomé health region in Togo. Togolese forest vegetation is poor alongside neighboring countries such as GHANA and IVORY COAST. It is generally composed of tree and shrub savannahs. In the Grand Lomé health region, there are certain tight forest assemblages extending along rivers. Hydrologically, the water table is superficial and not far from the natural terrain and even flush in places in the Grand Lomé health region throughout the year in almost all districts. It is supplied by hypodermic penetrations during the rainy season and does not sufficiently limit the quantity of water flowing.

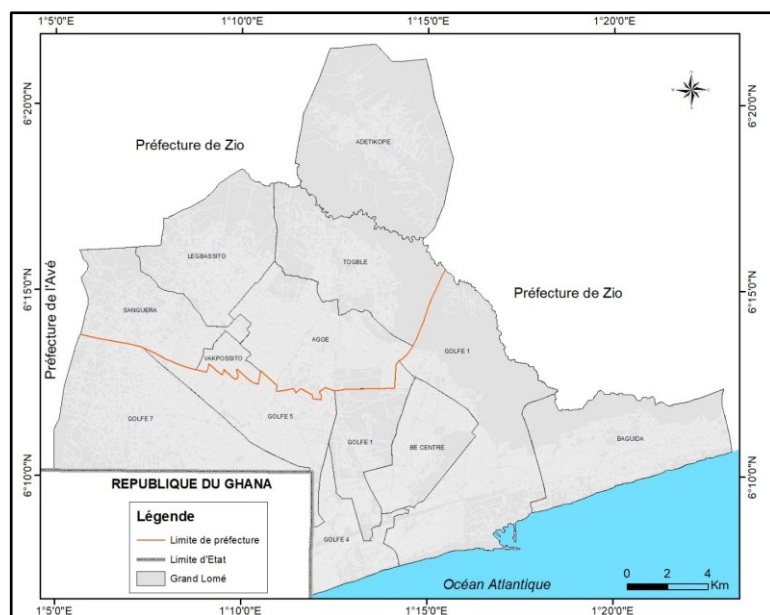


Figure 1. Geographical location of the Grand Lomé health region with its different municipalities.

Source: Ministry of territorial administration, decentralization and local authorities, adapted by Sondou.

This territory is divided into two prefectures (**Figure 1**): the Agoé-Nyvé prefecture and the Gulf prefecture. It is limited to the north by the prefecture of Zio (Maritime region), to the northwest by Avé prefecture, on the south side by the Atlantic Ocean, on the south-east side by the prefecture of Lacs, to the southwest by Ghana. The Gulf prefecture is located in the South while that of Agoé-Nyvé is located in the North. Thirteen municipalities make up these two prefectures, namely seven municipalities for the Gulf prefecture and six for that of Agoé-Nyvé.

The Greater Lomé region has an area of 425.6 km² and a population of 2,188,376 inhabitants according to INSEED (2022). In this area housing 40% to 50% of the national population and 80% of industrial and hotel infrastructure and equipment, the extent of climatic risks such as flooding are recurrent according to PNACC (2017).

The rise in sea level combined with plausible spring tides and storms will increase coastal erosion and the sinking of low-lying areas, leading to extraordinary retreats of the coastline between 160 m and 240 m over 30 km of coastline, between the Port and Agbodrafo, by 2030 according to PNACC (2017).

In Togo, the health system is under the responsibility of the Ministry of Health. It is organized according to a pyramidal structure with three levels: the first stage, the middle stage and the lowest stage. The first stage brings together the Minister's office, the general secretariat, general and central management. The middle stage concerns the health regions. The lowest stage works with prefectural health facilities. The Greater Lomé health region is made up of two health districts according to Houssou et al. (2015). On the one hand, this concerns the health district of Agoé-Nyvé and on the other hand, of the Gulf health district. The Greater Lomé health region has two reference hospitals according to Houssou et al. (2015). Under each district are the health facilities. The regional management and the two districts operate according to the Bamako initiative with the state operating fund while the two reference hospitals operate only with the state operating fund. It has a subequatorial climate characterized by an alternation of two rainy seasons and two dry seasons with average annual temperatures between 27.2 °C and 30 °C on the coast according to Houssou et al. (2015). Annual rainfall is low, 700 to 800 mm, due to the position of the coast in relation to the Monsoon flows and the limited number of squall lines in the area mentioned by the PNAS (2019).

This climate is dominated by two antagonistic trade winds including that of the North-East, regionally called harmattan (hot, dry and dusty) coming from the Sahara and the South-West trade wind or monsoon (humid) originating from the ocean. Atlantic. The demarcation zone (convergence) between these two trade winds is called the Intertropical Front (ITF) indicated the DGMN (2023).

Temperatures are high throughout the year, with low thermal amplitudes between seasons. The seasons are generally divided between a dry season and a rainy season. The Lomé area has five (05) dry months, namely January, February, August, November and December (**Figure 2**). The other months are rainy. The longest rainy period begins at the beginning of the third month of the year and ends in the seventh month. The shortest rainy period begins in the ninth month and ends at the beginning of the eleventh month. The shortest dry period occurs during the eighth month of the year while the longest dry period begins at the beginning of the eleventh month and ends at the end of the second month of the following year.

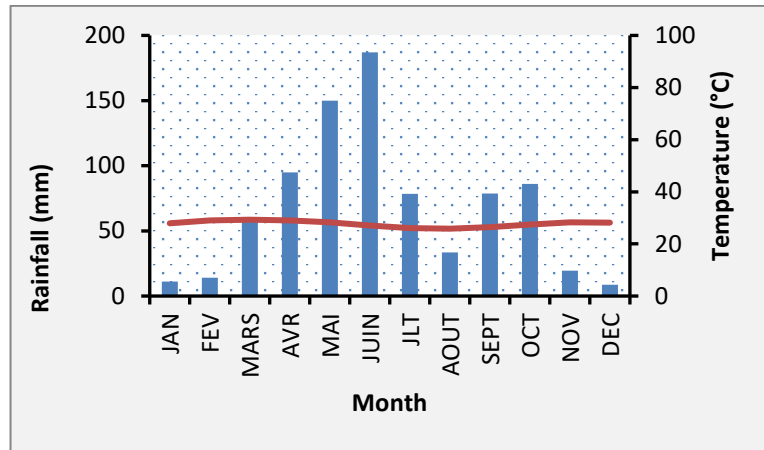


Figure 2. Climate diagram of Grand Lomé (1990–2023).

Source: Directorate General of National Meteorology (DGMN), 2023.

3. Results

This part allows us to present the results that we obtained from the people surveyed.

3.1. Climate data analysis

Following the analysis of **Figure 3**, we note a general trend towards a slight decrease in rainfall over the 1961–2023 time series considering the coefficient of variation ($a = -0.64$). This coefficient is negative. But from the year 2002, a change occurs in the chosen chronological series. From 2002 to the present day, we have noticed an improvement in rainfall in Lomé, therefore an increase in rainfall. The average of the series from 1961 to 2001 gives an average of 823.4 mm while that of 2002 to 2023 gives an average of 904.9 mm. The year 2002 is considered here as the year of rupture. This is the year from which we noticed this change, and the change is very significant (9.6%). Which means that the increase observed from 2002 is 9.6% compared to the average of the first series.

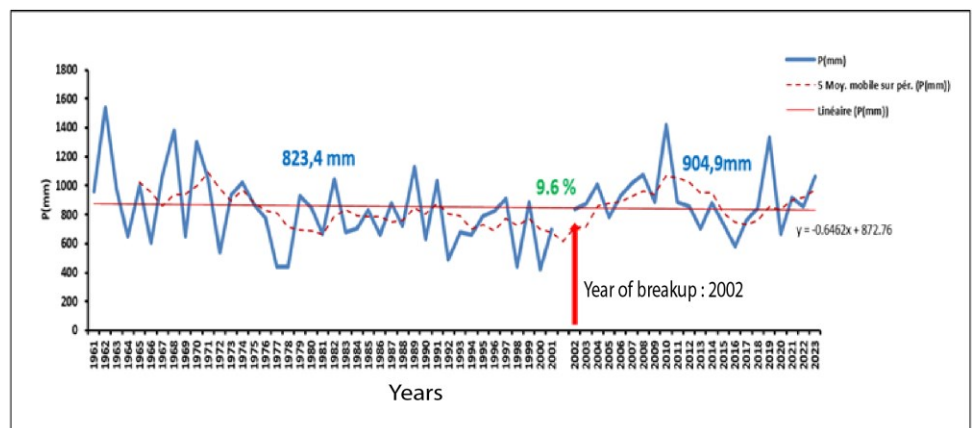


Figure 3. Rainfall evolution of Lomé from 1961 to 2023.

Source: Directorate General of National Meteorology (DGMN), 2023.

The analysis of **Figure 4** shows an increase in minimum temperatures from 1961 to 2023. The coefficient of variation ($a = 0.04$) is positive. But it was from 1986

onwards that a significant increase in minimum temperatures was observed. The average of the series from 1961 to 1985 gives an average of 23.0 °C while that of 1986 to 2023 gives an average of 24.4 °C. The year 1986 is considered here as the year of rupture. This is the year from which we observed this change, and the change is significant (+1.5 °C). Which means that the increase observed from 1986 is 1.5 °C compared to the average of the first series.

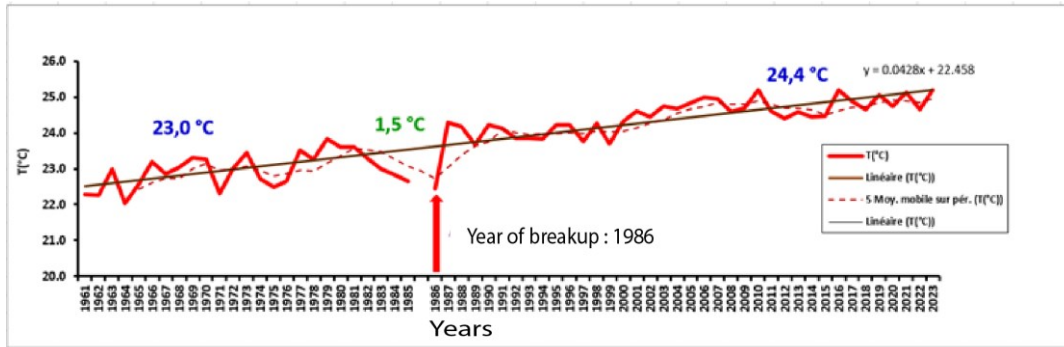


Figure 4. Minimum thermal evolution of Grand Lomé from 1961 to 2023.

Source: Directorate General of National Meteorology (DGMN), 2023.

By analyzing **Figure 5**, we see an increase in maximum temperatures from 1961 to 2023. The coefficient of variation ($a = 0.03$) is positive. But it was from 1994 onwards that a significant increase in maximum temperatures was observed. The average of the series from 1961 to 1993 gives an average of 30.7 °C while that of 1994 to 2023 gives an average of 31.9 °C. The year 1994 is considered here as the year of rupture. This is the year from which we observed this change, and the change is significant (+1.2 °C). Which means that the increase observed from 1994 is 1.2 °C compared to the average of the first series.

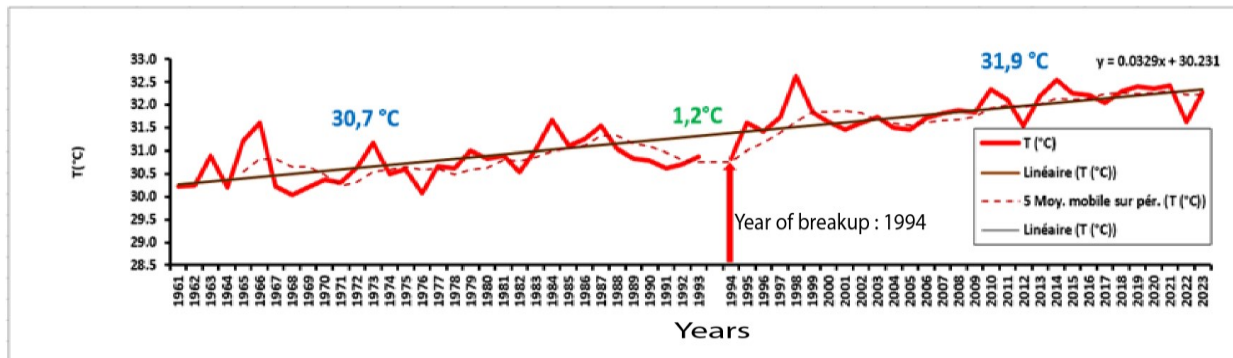


Figure 5. Maximum thermal evolution of Lomé from 1961 to 2023.

Source: Directorate General of National Meteorology (DGMN), 2023.

3.2. Perceptions of healthcare staff and clients regarding climate change

Around 75.95% of respondents perceive that climate change disrupts socio-economic activities. These perceptions arise from the fact that agricultural livelihoods are weather dependent; It is up to farmers to monitor and take into account weather and climate information when carrying out their activity. In addition, according to the people surveyed, they are aware of climate change through various sources, namely

92.31% through television, 84.62% through technical services, 61.54% through Internet users, 30.77% by reading the IPCC report and 7.69% through neighbors. Being aware of climate change, those interviewed say that they treat water in the event of flooding, empty pits and cesspools regularly and respect the medical waste management plan in the event of flooding. In the event of high heat, they store water and ventilate the rooms or use air conditioning, and also raise awareness. These observations prove that access to information on climate change is an important factor that influences the likelihood that health center managers will take adaptation measures. This finding proves that access to information about climate change is an important factor that influences the likelihood that health center managers will take adaptation measures. Regardless of gender, age, education and source of income, almost all respondents have some perception of climate change. A larger proportion of respondents (87.5%) noticed the change in climate parameters compared to what was observed in the past (during the last 5 years).

Health personnel and clients estimate that climate change was caused respectively at 81.46% by seasonal variations followed by deforestation at 78.47% and at 67.03% for the emission of greenhouse gases. Health personnel and clients estimate that climate change was caused respectively at 81.46% by the climatic anomaly followed by deforestation at 78.47% and at 67.03% for the emission of greenhouse gases. tight. Regardless of whether these links existed, respondents identified them as sources of concern and most health staff and clients' perceptions of climate change were strongly linked to observations of these trends.

The percentages of 61.86% and 38.15% of those questioned respectively perceived an increase in the quantity of precipitation and a shortening of the duration of precipitation. Furthermore, 35.02% of those questioned noted that the rains which should normally begin at the beginning of the fourth month of the year, now begin in the middle of the fifth month and sometimes in the sixth month. To understand why health workers and clients are affected by delays in rainfall due to their need for water according to Meze-Hausken (2004). Agriculture is one of the sources of livelihood. As a result, 74% of respondents say that climate variability is climate change is a serious problem to be solved. Understanding why health personnel and clients are concerned about excess rainfall. It must be recognized that in the current context of climate change, there is an increase in flooding in the health region of Grand Lomé and its surroundings. The start of the rainy seasons is late and the end is early (the period of rainy seasons is short). Rainy seasons don't last with an uneven distribution of rain throughout the season normally indicated for rains. The rains then concentrate over a short period. The ground having already been sufficiently saturated with water, the excess is released, causing flooding. Additionally, the extreme rainfall event, such as increased precipitation, influenced the experiences and perceptions of healthcare workers and clients regarding climate-related hazards.

The Greater Lomé health region has an oppressive and wet climate, accompanied by small annual variations in periods. Referring to the last normal (1991–2020), the thermal average oscillates between 26.2 °C and 29.6 °C, while the relative humidity varies from 77% to 84%. The average annual rainfall varies between 700 mm and 1416.7 mm. If we refer to the analysis of the preceding data, we notice that the perceptions of the people interviewed differ from one person to another. This is

sometimes explained by the level of information on climate change and its impacts on health. Also by the level of education, the level of access to information, the sources of information received and the influence of tradition (because some people think that it is non-compliance with prohibitions and disobedience of the gods) and recommends sacrifices to ask forgiveness from the gods.

3.3. Scientific assessment of climate variation

A thirty-year study of information on annual rainfall at the Lomé station demonstrates climate variability in the Greater Lomé health region. This information indicates that a very significant variation from the first series average of 9.6% of precipitation occurred in 2002. After the year 2002, precipitation showed an upward trend for 21 years. However, there has been a decrease in the rainy period. Furthermore, the study by Adewi (2012) in the Greater Lomé health region supports this assertion that the dry season tends to lengthen and the rainy season shortens with increased concentration of rainfall thus causing flooding. According to the same author, this crisis is manifested by a drop in rainfall, a delay in the start of the rainy season, a reduction in its duration, the early onset of the dry season and a reduction in the number of days. Similarly, research carried out by Wilk et al. (2001) agrees with this statement regarding the decline in the period of precipitation in the northern part of Thailand. The temperature variations were also remarkable.

3.4. Perceptions of health staff and clients regarding climate-related hazards

Health staff and clients perceive drought, floods, strong winds, heat waves as major risks linked to climate change which cause disruptions to health systems in the Grand Lomé health region. Information on these dangers is essential. Knowing the environmental situation, the local population's understanding of climate-related hazards and their impacts seems important to help environmental managers as well as political decision-makers to prepare to minimize impacts. plan measures to minimize the consequences.

3.4.1. Perception of drought by health staff and clients

Drought is a recognized risk in the Greater Lomé health region which occurs each year between November and March for the long dry season and between July and September for the short dry season. However, 65.29% of people interviewed reported worsening periods of drought over the past five years, which they believe signals a drought. They perceived periods of drought as periods when precipitation was less, late or absent. Generally speaking, 34.16% as well as 35.02% of respondents reported the decrease in the frequency of precipitation (break of rains in peak season) and late precipitation (delay in the start of rains) as the main causes of drought. According to surveys, these situations have arisen every year over the past 5 years. The variation in rainfall causes misunderstandings in the acceleration of drought periods. People who have understood that there are fewer periods of precipitation have also understood that there is an acceleration of periods of drought. According to the results, health workers and clients suffered from the consequences of the drought, namely respiratory tract infections (lower and upper), cerebrospinal meningitis and were the causes and deaths

in hospitalization especially among children under 5 years in health centers in the Grand Lomé health region in 2019, 2020, 2021 and 2022 mentioned by Sene and Ozer (2002). According to research on evaluation concerning the vulnerability of health systems to impacts climate risks carried out by GIZ (2019), the risk of increased morbidity and mortality rates linked to respiratory infections and meningitis are direct effects of climate change.

In addition, 34.91% of those consulted perceived water shortages. The increase in dry periods has implications for the survival of populations. It creates an economic slowdown by reducing agricultural yield.

3.4.2. Perception of flooding by health personnel and clients

Health personnel and clients in the Grand Lomé health region found flooding as excess water in their environment. Generally, 50% of health centers experienced flooding according to respondents. In addition, 77.27% of respondents understand that rising sea levels lead to an increase in water levels causing flooding in health centers and homes located in the coastal zone. The results obtained confirm that health personnel and clients experiencing heavy rainfall perceived increasing trends in flooding. Respondents reported that the rains were heavy and lasted up to 6 days and reached a height of 3 m causing flooding. Health staff and clients pointed out that flooding has impacts such as diarrheal diseases as mentioned by Rubin (1998). This is in the same vein as Danielsen et al. (2005) and Hung et al. (2012) maintain that environmental problems, particularly hygiene and sanitation, are essentially linked to food and the sanitation of the living environment and contribute to the increase in cases of water-borne diseases. However, respectively 58.56% and 61.59% of respondents perceive that the rapid degradation of distribution network systems (e.g., energy, electricity, water, gas, etc.), and regular air pollution and water are problems linked to climate change. Likewise, 54.97% of those surveyed perceive that the increase in diseases during rainy seasons are problems attributable to variations in temperatures and weather conditions. According to Dhis2 (2023), Malaria is the cause of hospitalization and death especially among children under 5 years old in health centers in the Grand Lomé health region. Percentages of 45.45% in 2019, 45.6% in 2020, 41.57% in 2021 and 38.23% in 2022 were reported according to Dhis2 (2023) (see appendix). According to the respondents, high heat (heat stroke) is perceived by 70.4% and stress is perceived by 47.8%.

According to environmental assessments, flooding in the Greater Lomé health region is also the result of the degree of vulnerability to risks encountered in the area. This result is consistent with the literature according to which: “In Sahelian cities, floods and other climatic events are also due to the inadequacy in the application of regulations relating to territorial planning and humanitarian action on the environment” mentioned by Sene and Ozer (2002). Consequently, it is necessary to rethink compliance with town planning regulations because these risks can be minimized.

Likewise, health center leaders' efforts to mitigate flooding alone cannot solve the problem. It is essential to put in place mitigation strategies. Regarding the rise in sea level, 15.15% of respondents confirm and agree with the results of the analysis of the CPDN Togo document, which say that the country has a maritime coast of 50 km subject to erosion.

3.4.3. Perception of temperatures by healthcare personnel and clients

In the Grand Lomé health region, health personnel and clients have simply perceived 84.62% of high heat over the last 5 years. These results corroborate with several studies that link rising temperatures, abnormal rainfall trends, strong winds, sea level rise and drought to the climate changes indicated by PNAS (2019) and the DGMN (2023). Those interviewed believe that the thermal working conditions make them uncomfortable. These results corroborate with several studies that link rising temperatures, abnormal rainfall trends, violent winds, sea level rise and drought to climate change according to PNAS (2019) and the DGMN (2023). In the same vein as Kévin (2023) affirmed that thermoregulation, the humidity level which influences sweating puts workers in discomfort. These results support the idea that climate impacts will reduce the capacity of health systems to meet the essential demands of populations (Mullins-Jaime, 2021).

3.5. Scientific assessment of climate risks

3.5.1. Drought

Examination of the results from the Lomé station indicates that in the Greater Lomé health region, the major dry period begins in the middle of the eleventh month of the year and ends in the middle of the third month of the following year, which does not necessarily mean good weather. The atmosphere remains very humid and the sky can be cloudy for several days, especially when the harmattan blows according to DGMN (2023). The short dry season is the one which goes from mid-July to mid-September, it is very pleasant (although a few drops may fall from time to time).

Examination of the precipitation results from the Lomé station indicated a downward variation in rainy periods with late starts. These indications agree with the responses of those questioned about the acceleration of droughts.

3.5.2. Flood

In the Greater Lomé health region, the main rainy season extends from mid-March to mid-July. The short rainy season lasts from mid-September to mid-November. These results are consistent with respondents' perceptions of flooding due to increased precipitation, temperatures, and melting Arctic ice (increasing sea levels) over the past five years. Togo, and in particular the Greater Lomé health region, is not yet experiencing ice or snowfall. These results require a focus on flood prevention awareness and adaptation programs.

3.5.3. Heat waves

According to scientific evidence, the thermal evolution of the Lomé station shows two trends, namely the minimum and maximum thermal evolution. There has been an increase in minimum and maximum temperatures since 1961 until 2023. It was from 1986 that a significant increase in minimum temperatures was noted while that in maximum temperatures was noted from 1994. This scientific evidence agrees with the perception of those interviewed, because 87.5% of those interviewed noticed the change in climate parameters compared to what was observed in the past.

3.6. Test on the impact of climate risks on the health system.

A *P*-value less than 0.05 (threshold considered for this study) is generally considered statistically significant. In this case, looking at the results in table, all *P*-values are well below this threshold, which indicates that the results are statistically significant (**Table 1**). This means that, for each of the climate risks tested, there is a significant relationship between these risks and their potential impact on health systems in Greater Lomé. The results thus confirm the hypothesis according to which climatic risks such as floods, strong winds, rising sea levels, drought, heat waves and pollution (air, water, food) affect systems health in Greater Lomé. Although all climate risks are significant, those with the lowest *P*-values (e.g., excess rainfall/flooding and high winds) could be considered to have a potentially higher or more immediate impact, which could guide prioritization interventions.

Table 1. Results of the Khi two test on the impact of climate risks on the health system.

Climate risks	<i>P</i> -value
Excess rainfall/flooding	0.000
Strong winds	0.000
Sea level rise	0.010
Drought	0.001
Heat waves	0.006
Air-water-food pollution	0.001

4. Discussion

Evaluating the perceptions of health personnel and clients on the impacts of climate change allows health system managers to consider adaptation strategies to implement. The results of this study reveal irregularities and delays in rains. These results are consistent with those of Meze-Hausken (2004) in terms of water stress observed. The rainy seasons are unevenly distributed with shorter and more intense periods, thus leading to recurrent floods.

According to scientific observations, the increase in rainfall from 2002 to the present in the Grand Lomé health region is clearly defined. The increase in minimum temperatures is remarkable from 1961 to 2023 as are maximum temperatures. These results are similar to a study carried out in the area by Adewi (2012). Similarly, the work of Wilk et al. (2001) is consistent with the idea that a regression in the frequency of precipitation has been observed. in northern Thailand. The temperature anomalies were remarkable. The impacts of drought, namely respiratory tract infections (lower and upper), cerebrospinal meningitis perceived by the respondents confirm the results according to which the causes and deaths in hospitalization especially among children under 5 years old in health centers health of the Grand Lomé health region in 2019, 2020, 2021 and 2022 mentioned by Sene and Ozer (2002) as well as GIZ (2019). According to our study, floods have impacts such as diarrheal diseases, cholera, malaria. These results corroborate with those of Rubin (1998). Also, Danielsen et al. (2005) and Hung et al. (2012) confirm in their studies that environmental problems,

particularly hygiene and sanitation, are essentially linked to food and the sanitation of the living environment and contribute to the increase in cases of water-borne diseases. Referring to Dhis2 (2023) of the Ministry of Health and Public Hygiene of Togo, malaria is the cause of hospitalization and death especially among children under 5 years old in health centers in the Grand Lomé health region.

Percentages of 45.45% in 2019, 45.6% in 2020, 41.57% in 2021 and 38.23% in 2022 were reported. According to Sene and Ozer (2002), floods are also caused by Territorial planning: “In Sahelian cities, floods and other climatic events are also due to the inadequacy in the application of regulations relating to territorial planning and humanitarian action on the environment”. This study contradicts field observations due to the degree of vulnerability to risks encountered in the area. Therefore, health centers that are geographically well located are more resilient to climate risks than health centers that are located in locations geographically vulnerable to climate risks. The increases in temperatures perceived in the Grand Lomé health region corroborate with PNAS (2019) and the DGMN (2023) which attest to the increase in temperatures, abnormal rainfall trends, violent winds, rising sea levels and drought. Similarly, Kévin (2023) confirms that thermoregulation and the humidity level which influences sweating make workers uncomfortable. In support of our findings, research by Mullins-Jaime (2021) indicates that, climate variation disrupts the proper functioning of health systems.

5. Conclusion

This work aimed to analyze the perceptions of health staff and clients on climate change and dangers in the Greater Lomé health region of Togo. It was carried out based on field observations and surveys using a questionnaire among health personnel and clients. Nearly 75.95% of healthcare workers and clients have personally perceived climate change and know that it is occurring through various sources. A comparison of the perceptions of health personnel and clients with scientific assessments indicate respectively gives 61.86% as 38.15% of those questioned realized excess rainfall in terms of an increase in precipitation and a reduction the duration of precipitation over the past five years. On the other hand, 53.22% perceived an increase in temperature thus putting the respondents in discomfort. However, 65.29% of those interviewed perceived an increase in drought, thus causing economic and health repercussions. All this information on rainfall indicated above has attested to the manifestation of climatic variability. A significant number of respondents (83.04%) indicated that climate variations constitute an environmental difficulty to manage. this statement is consistent with the concept of environmental management adopted for the involvement of all stakeholders. The environment of healthcare establishments is a concern for everyone as Wachter (2011) said. The results of the study confirm that climate change will increase risks to the well-being of the Togolese population, not only due to health risks, but also due to extreme weather phenomena observed if adaptation and mitigation are not implemented by those responsible. for healthcare establishments. Scientific observations of precipitation agree well with perceptions of caregivers and clients. Efforts by health center managers to mitigate flooding alone cannot lead to effective measures. To this end, awareness and adaptation programs

should focus on mitigating floods, droughts and heatwaves. In this way, this work provides important details on the health needs created by climate disruption, climate-related risks and their manifestation with indigenous realities. Also, gives suggestions for solving problems and strengthening adaptation measures in health systems. The results of this work will help decision-makers understand and facilitate the management of risks linked to climate change in the Greater Lomé health region. However, another study is necessary to analyze the different strategies that are put in place in a practical and behavioural manner to deal with these different impacts perceived by health personnel and clients in these health establishments.

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