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Article

Climate risks on health systems in the greater Lomé health region of Togo (West Africa) in 2022: Manifestations of the effects

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Abstract: Climate change has adverse effects on ecosystems and several socio-economic sectors including health. Indeed, infrastructure, continuity of medical services, and the hospital environment are all directly affected by the effects of climate-related risks. This study aims to describe the observations of the effects of climate change risks on health systems in the Greater Lomé health region of Togo. We used an interview guide and a questionnaire to collect information. The observations allowed us to assess the effects caused by climate risks. According to the results, 84.62% of respondents attest that health centers experience flooding during rainy periods and damage caused by strong winds is noticeable among 76.92% of respondents. More than 25.40% and 61.86% respectively of respondents mention that droughts and floods have effects on health systems. The results of this study will allow health system managers to become aware of how to plan useful actions to facilitate the management of climate-related risks in health facilities in the Greater Lomé health region. In view of all these results, it is necessary that measures be taken to strengthen the resilience of health systems through awareness campaigns and training of actors throughout the health pyramid.

Keywords: climate risk; Greater Lomé; effects; health facilities

1. Introduction

Climate change poses a major threat to human health in the 21st century. According to climate models, global warming will be inevitable up to a value of 4.8 ℃ in the future if mitigation policies are not applied (Keita and Zoumana, 2024). Climate change is causing disruptions to many environmental elements (Alassani, 2022) and the risks to health and health systems are increasing. These risks often lead to loss of life, destruction of property and outbreaks of various diseases. All countries in the World have a common problem in recent years which is the increase in climate risks. Overall and globally, climate risks influence public health care. Climatic variability leaves remarkable effects on the components of the environment today (Alassani, 2022; Harvey, 2023). Thus, climate change is the source of many health problems throughout the world and especially in developing cities where the population suffers from the lack of health infrastructures and financial problems. Increased frequency of heavy rains could cause flooding and reduce usable land (Keita and Zoumana, 2024). Likewise, this resurgence of floods has impacts on public health through the emergence of diseases.

Health workers and clients developed a relationship and an interpretation of their living environment. thus, they used their dependence on the climate to adapt and carry

out their activity (Rubin, 2023). Therefore, perceptions of health workers and clients may reflect local issues (Danielsen et al., 2024). The difference between local opinions and assessments indicated the importance of raising awareness among leaders and the community about flood risk.

Like floods, extreme climatic events are important factors of vulnerability of populations (Keita and Zoumana, 2024). The risk of flooding is currently the most widespread and natural risk causing more victims and damage (Koumassi, 2014). It is the basis of 58% of the number of victims and 31% of the amount of economic losses (Sow and Thiaw, 2024).

In order to find a favorable outcome to climatic hazards which constitute a danger for safety and health, it is essential to consider the perception of risks such as floods, drought and coastal erosion. These risks must be considered because they have been examined to determine impacts and predict future trends (Kevin, 2020). Also, as tested in some studies, human beings should first accept that climate change is anthropogenic, a human-caused problem that needs human action. The literature shows doubt towards anthropogenic climate change as a barrier to acceptance and action of climate science (Poortinga et al., 2015; van der Linden et al. 2015).

Second, it has been agreed that climate risks have adverse effects. also, the literature confirms that these negative effects on health resulting from climate risks are at the origin of the demotivation to take response measures (Bouman et al., 2020; Petrovic et al., 2014). Thirdly, believing in the good outcomes of human efforts to cope with climate change as expectations and instrumental aspects of motivation. It is important to pay particular attention to the changes that climate disruption will induce on health systems. According to WHO (2015), the health system corresponds to the organizations, institutions and resources that promote arrangements to improve, protect or restore health. Health systems are significantly negatively impacted by climate variability. this statement no longer needs to be demonstrated and health center managers must take necessary measures because climate risks persist and will have a greater impact on centers which will be poorly prepared to face them.

The African continent is constantly experiencing extreme weather events, such as floods caused by torrential rains, which cause a lot of damage. This situation was demonstrated by the IPCC and confirmed in West Africa (Layan et al., 2024). Indeed, the risks related to climate change persist in the Greater Lomé health region. Analysis of the results of scientific research has shown an increase in the magnitude and frequency of rains and floods in this health region. The Greater Lomé health region, due to its geographical, physical and geomorphological framework is suffering the consequences of climate change. Thus, the general objective is to study the effects of climate risks in health facilities in the Greater Lomé health region in Togo. More specifically, the first step will be to describe the effects of climate risks on hospital infrastructures in health facilities and the second step will be to describe the effects of these risks on the hospital environment.

2. Materials and methods

The Greater Lomé health region is characterized by a subequatorial climate consisting of an alternation of two dry seasons and two precipitation seasons with

average annual temperatures recorded between 27.2 ℃ and 30 ℃ (Houssou et al., 2015). Due to the position of the coastline relative to the monsoon flows and the limited number of squall lines in the area, annual precipitation is low and ranges between 700 and 800 mm. Made up of two prefectures, namely the Agoé-Nyvé prefecture and the Golfe prefecture, the Grand Lomé health region is bordered to the south by the Atlantic Ocean, to the southwest by Ghana, to the southeast by the Lacs prefecture, to the northwest by the Avé prefecture, to the north by the Zio prefecture (Maritime Region). The Agoè-Nyivé prefecture is located in the North while that of Golfe is located in the South. The Grand Lomé health region is made up of thirteen communes spread across the two prefectures, namely seven communes for the Golfe prefecture and six for that of Agoé-Nyvé. The **Figure 1** highlights the health region of Greater Lomé with its two prefectures and the health facilities concerned by our research.

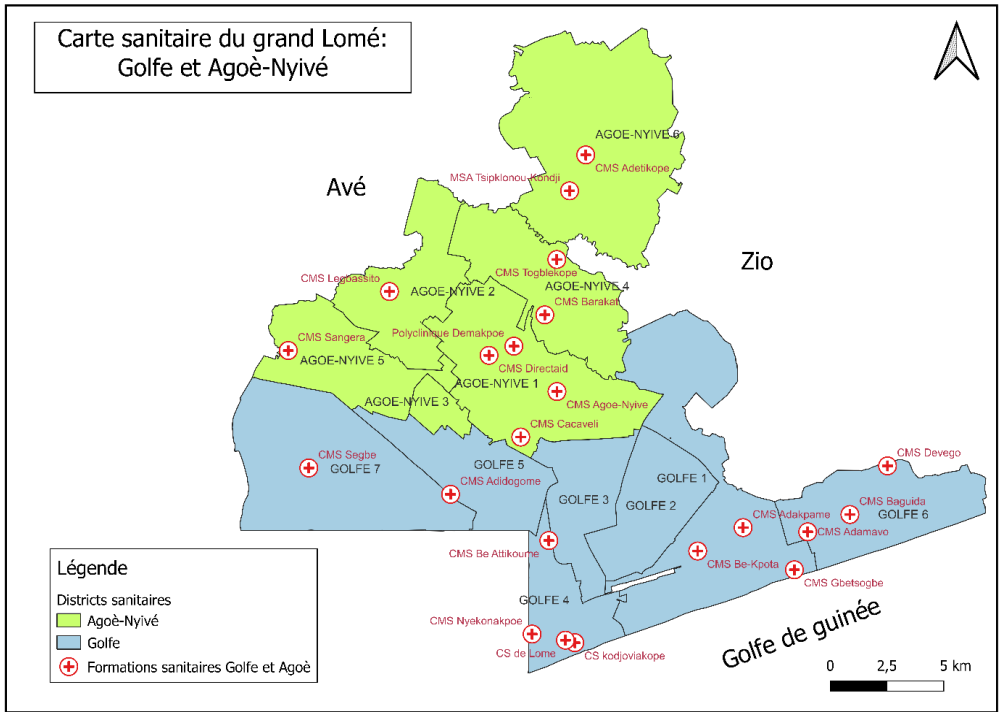

Figure 1. Health map of Greater Lomé.

Source: ISSA, 2024.

The population of the Greater Lomé health region is 2,188,376 inhabitants according to INSEED (2022) and an area of 425.6 km^2. This region is made up of 40 to 50% of the national population and 80% of the industrial and hotel infrastructure and equipment. Climate risks such as flooding are recurrent. Rising sea levels combined with probable spring tides and storms will increase the subsidence of low-lying areas and coastal erosion, causing abnormal coastal retreats of between 160 m and 240 m over 30 km of coastline, between the Port and Agbodrafo, by 2030. The responsibility for the health system in Togo lies with the Ministry of Health and Public Hygiene. It is composed of three levels namely the first level, intermediate level and the lowest level. The first level includes the Minister's office, the general secretariat, and the general and central management. The intermediate level is made up of the

health regions. The lowest level works with the prefectural health establishments. The health region of Greater Lomé is composed of two health districts: Golfe and Agoé-Nyvé according to Houssou et al. (2015). It contains two reference hospitals. Under each district are the health establishments. To collect the data for our study, we relied on primary and secondary sources and we also relied on the Canadian Coalition for Green Health Care's tool, on climate change in health care settings. This is a resilience toolkit that healthcare facilities can use to assess their resilience to climate change: Health Care Facility Climate Change Resiliency Checklist (CCGHC, 2013).

We administered the questionnaire based on qualitative participatory approaches frequently used for studies. The questionnaire gathered two major parts as follows: general information on climate risks in this region and perceptions on the manifestation of the effects of climate risks on health systems.

Both open and closed questions were administered in view of previous studies as mentioned by Deng et al. (2012).

The choice of health personnel was based on the years of experience in the position. The targets of this survey were health service managers who already have experience of bad weather in the health facility of at least 1 year.

We consulted the scientific documents of university and administrative structures related to our theme. The data processing were performed using Microsoft Excel-2010 and IBM SPSS Statistics 21 software. The missing data were handled using the list wise elimination method (Acock, 2005). Fisher's exact and multinomial logistic regression tests were performed independently of descriptive statistics.

3. Results

In this part, we will discuss the results of our study.

3.1. Climate change

The **Table 1** presents the climatic risks to which health establishments in the Greater Lomé health region are exposed.

Table 1. Exposure of health facilities to climate risks- Administrations: Biomedical service, infrastructure.

Climatic risks/hazards (events)	Yes	No
Golf		
Excess rainfall/flooding	30 (45.45%)	36(54.55%)
Strong winds	11 (16.67%)	55(83.33%)
Sea level rise	10 (15.15%)	56(84.85%)
Drought	12 (18.18%)	54(81.82%)
Heat waves	26 (39.39%)	40(60.61%)
Air-water-food pollution	20 (30.3%)	46 (69.7%)
Agoé Nyive		
Excess rainfall/flooding	36 (78.26%)	10(21.74%)
Strong winds	23 (50%)	23 (50%)
Sea level rise	-	45 (100%)

Drought	15 (32.61%)	31(67.39%)
Heat waves	32 (69.57%)	14(30.43%)
Air-water-food pollution	9 (19.57%)	37(80.43%)

Source: Field data, 2022.

Referring to **Table 1**, the exposure of health facilities to climate risks in the two districts is remarkable. Thus, 45.45% of respondents in the Golfe health district indicate that their health facilities are often flooded and 30.3% polluted (air-water-food). In addition, 39.39% experience periods of heat waves; 18.18% perceive periods of drought; 16.67% are affected by strong winds and 15.15% perceived the effects of rising sea levels. In that of Agoé Nyvé, 78.26% of health facilities are practically flooded during heavy rainfall; 69.57% experience heat waves; 50% are affected by strong winds; 32.61% experience periods of drought; and 19.57% experience periods of pollution. The **Figure 2** shows an example of a health facility exposed to the risk of flooding.

(a) **(b)**

Figure 2. Flooded health facilities. **(a)** in front of the medical consultation room; **(b)** in front of the Sanitation-Vaccination department.

Source: Field data, 2022.

3.2. Future climate risk trend

The **Table 2** shows the trend of climatic risks predicted according to the respondents to whom the health establishments of the Greater Lomé health region will be exposed.

Table 2. Future climate risks.

	YES	**NO**
More pronounced dryness	11 (84.62%)	2 (15.38%)
Frequent flooding	11 (84.62%)	2 (15.38%)
Significant drop in rainfall	9 (69.23%)	4 (30.77%)
Significant increase in rainfall	9 (69.23%)	4 (30.77%)
High temperature	11 (84.62%)	2 (15.38%)
More remarkable sea level rise	11 (84.62%)	2 (15.38%)

Strong winds more pronounced	12 (92.31%)	1 (7.69%)

Source: Field data, 2022.

Table 2 shows that 84.62% of respondents are aware of future climate change. Thus, floods will be more frequent according to 84.62% of respondents, a decrease in rainfall is indicated by 69.23% of respondents, a significant increase in rainfall according to 69.63% of respondents, high heat is noted by 84.62% of respondents, a significant rise in sea level according to 84.62% of respondents and strong winds will be more pronounced by 92.31% of respondents.

3.3. Sources of information on future climate risks

The **Figure 3** shows the sources of information of the respondents on climate risks in the future.

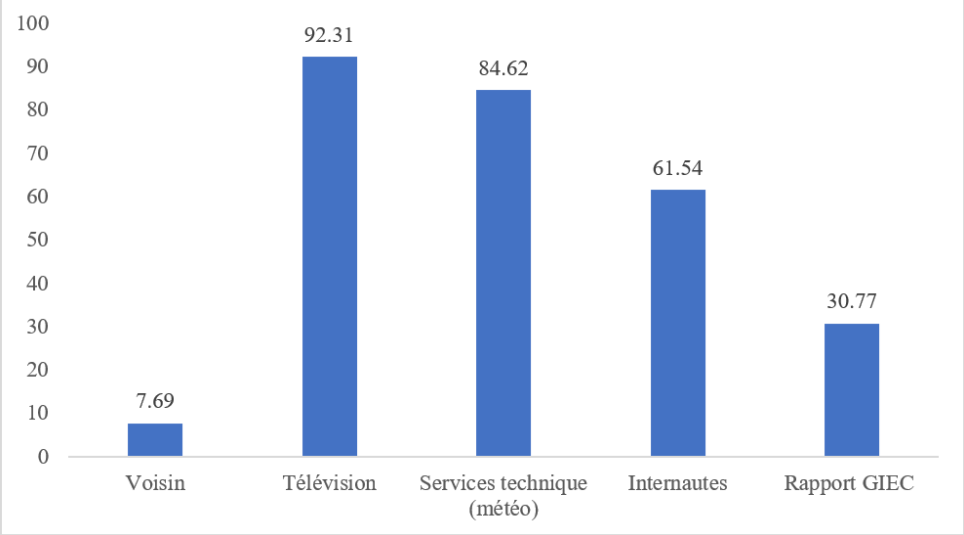

Figure 3. Source of information on predicted climate risks.

Source: Field data, 2022.

The source of information is crucial for guiding strategies in the fight against risks related to climate change. **Figure 3** presents the different information channels according to the people interviewed. It indicates that 92.31% of respondents received information on predicted climate change through television, technical services played this role of information channels according to 92.31% of people, Internet users participated according to 61.54% of people, the IPCC report concerns 30.77% of respondents and 7.69% of the population received information through neighbors.

3.4. Demonstration of the effects of climate risks on hospital infrastructures

The **Table 3** shows the effects of climate risks on hospital infrastructure.

Table 3. Different types of effects on hospital infrastructure.

	Golf (66)		**Agoe Nyive (41)**	
	Yes	**No**	**Yes**	**No**

Affects the efficiency, lifespan and safety of infrastructure and buildings	46 (69.7%)	20 (30.3%)	30 (73.17%)	11 (26.83%)
Subsidence of structures	28 (42.42%)	38 (57.58%)	33 (80.49%)	8 (19.51%)
Fast amortization	27 (40.91%)	39 (59.09%)	13 (31.71%)	28 (68.29%)
Power outage	31 (46.97%)	35 (53.03%)	13 (31.71%)	28 (68.29%)
Overflowing pits and sumps	27 (40.91%)	39 (59.09%)	14 (34.15%)	27 (65.85%)
Corrosivity of materials	34 (51.52%)	32 (48.48%)	12 (29.27%)	29 (70.73%)
Roofs uncovered	31 (46.97%)	35 (53.03%)	28 (68.29%)	13 (31.71%)
Water invading buildings	27 (40.91%)	39 (59.09%)	30 (73.17%)	11 (26.83%)
High aggressiveness on materials used for construction	27 (40.91%)	39 (59.09%)	13 (31.71%)	28 (68.29%)
The coating of the reinforcements becomes larger (more expensive to produce) because of the salinity of the air	33 (50%)	33 (50%)	12 (29.27%)	29 (70.73%)
Cracking of protective slabs	46 (69.7%)	20 (30.3%)	32 (78.05%)	9 (21.95%)
Moisture in buildings (mold)	37 (56.06%)	29 (43.94%)	33 (80.49%)	8 (19.51%)

Source: Field data, 2022.

Table 3 shows that 69.7% of respondents in the Golfe district and 73.17% in the Agoé Nyvé district say that climate change affects the efficiency, lifespan and safety of infrastructure and buildings. A proportion of 42.42% in the Golfe district and 80.49% in the Agoé Nyvé district talk about the subsidence of structures; 46.97% versus 31.71% report power cuts. Almosr 47% of respondents in the Golfe district and 68.29% in the Agoé Nyvé district report the unroofing of roofs. In the information gathering process, 40.91% of respondents in Golfe and 73.17% in Agoé Nyvé noted the invasion of buildings by water; 50% versus 29.27% say that the coating of the reinforcements becomes larger (more expensive to carry out) because of the salinity of the air; 69.7% versus 78.05% speak of the cracking of the protection slabs and 56.06% versus 80.49% say that an increase in humidity in buildings is noticed. The **Figure 4** highlights the effects of climate hazards on health infrastructures.

(a) **(b)**

Figure 4. Effects of climate hazards on health infrastructures.

Source: Field data, 2022.

4. Demonstration of the effects of climatic risks on the hospital environment

The **Table 4** shows the effects of climatic risks on the hospital environment.

Table 4. Different types of environmental effects.

	Golf (66)		**Agoe Nyive (46)**	
	Yes	**No**	**Yes**	**No**
Degradation of distribution network systems (e.g.: electrical energy, water, gas, etc.)	40 (60.61%)	26 (39.39%)	26 (56.52%)	20 (43.48%)
Air pollution	44 (66.67%)	22 (33.33%)	26 (56.52%)	20 (43.48%)
Food pollution (food poisoning)	41 (62.12%)	25 (37.88%)	16 (34.78%)	30 (65.22%)
Water pollution (waterborne diseases)	46 (69.7%)	20 (30.3%)	26 (56.52%)	20 (43.48%)
Lack of hand hygiene	30 (45.45%)	36 (54.55%)	13 (28.26%)	33 (71.74%)
Lack of hygiene of biomedical materials	19 (28.79%)	47 (71.21%)	8 (17.39%)	38 (82.61%)
Unsanitary environment of the health facility	35 (53.03%)	31 (46.97%)	25 (54.35%)	21 (45.65%)
Mismanagement of medical waste	26 (39.39%)	40 (60.61%)	15 (32.61%)	31 (67.39%)
Water shortage	26 (39.39%)	40 (60.61%)	14 (30.43%)	32 (69.57%)
Degradation of waste management infrastructure (incinerators, burners and others)	23 (34.85%)	43 (65.15%)	11 (23.91%)	35 (76.09%)
Bad smells	31 (46.97%)	35 (53.03%)	23 (50%)	23 (50%)
Proliferation of insects and rodents (mosquitoes, flies, rats, etc.)	40 (60.61%)	26 (39.39%)	20 (43.48%)	26 (56.52%)
Mosquito bite	41 (62.12%)	25 (37.88%)	22 (47.83%)	24 (52.17%)

Source: Field data, 2022.

When addressing the different types of effects on the environment of health facilities, the results in **Table 4** confirm their existence. Thus, 60.61% in the district of Golfe and 56.52% in that of Agoé Nyvé attest that the degradation of the distribution network systems (e.g.: electricity, water, gas, etc.) is partly linked to climate change. Air pollution was noted among 66.67% of respondents in Golfe and 56.52% in Agoé Nyvé. For water pollution, 62.12% in Golfe and 34.78% in Agoé Nyvé. Addressing the unsanitary environment of the health facility, 53.03% against 54.35% were recorded whereas the proliferation of insects and rodents were observed among 60.61% of respondents in Golfe and 43.48% in Agoé Nyvé. Mosquito bites were a concern among 62.12% of respondents in the Golfe district and 47.83% in that of Agoé Nyvé. The **Figure 5** presents the state of the items stored in the flooded stores.

(a) **(b)**

Figure 5. Flooded in storage stores

Source: Field data, 2022.

5. Discussion

The Grand Lomé health region has five (05) dry season months. The short rainy season concerns the months of September, October and mid-November. The long rainy season goes from mid-March, April, May, June and mid-July and June is the wettest month. These months correspond to the wettest period of the year during which the rain is greater than the potential evapotranspiration (Djohy et al., 2015). During this period, we generally see an increase in cases of waterborne diseases (gastroenteritis, malaria, cholera, etc.) due to the increase in the rate of insalubrity, the contamination of water tables and drinking water sources (Houssou et al., 2015). The short dry season is centered on the month of August while the long dry season runs from mid-November to the end of February. These periods correspond to times of temperature increases, thus favoring the development cycle of vectors of waterborne diseases (WHO and WMO, 2012). These thermal changes of the dry period effectively participate in the establishment of ecological conditions for the development of pathogens (mosquitoes, flies, ticks, etc.) and also favor their migration from natural environments to human habitations (Azondjinmon, 2020). The comparison of rainfall averages in the region shows a decrease rate of 8%. This decrease is observed from the year 2002. This is comparable with the results of the study by Ibrahim et al. (2016).

According to these authors, the evolution of rainfall results in an increase in temperatures. This decrease in rainfall reflects the period of drought which actively impacts on agricultural production. According to the results of our previous research, it was noticed that climate change is the cause of increasing climate risks. On the health front, climatic risks are at the origin of respiratory diseases leading to the causes of death in healthcare settings, especially among children under five years old. particularly among children under 5 years old in our study region in recent years (GIZ, 2019). Referring to the results of Rubin (2023) and those of our study, the increase in

rainfall causes floods which are very often sources of the appearance of diarrheal diseases, cholera and malaria. In this same vein, the studies of Danielsen et al. (2024) provide support by confirming these results. Indeed, it is noted that flooding does not constitute a risk in all health facilities. Continuity of services is well established in those that are well prepared as mentioned by Keita and Zoumana (2024). "urbanization is also a flood risk factor because if the city is poorly planned, it contributes to the occurrence of risks". Consequently, the hypothesis put forward for our study should not be generalized in all health facilities in the Greater Lomé health region. The thermal evolution in this region poses a major public health problem, especially since the results of the study demonstrated the progressive increase in temperatures. The symptoms presented by patients in relation to this increase are hyperthermia, headaches, loss of consciousness or dizziness (Diallo, 2024). Climate change has a direct impact on certain categories of diseases. First of all, on vector-borne diseases, by making the conditions for survival and reproduction of vectors more favorable. In addition, increased precipitation increases the spread of infectious agents and temperature favors their growth, thus making waterborne or food-borne diseases very susceptible to climate change (Layan et al., 2024).

Furthermore, the harshening of climatic conditions also leads to a deterioration in air quality and promotes certain diseases such as respiratory infections or meningitis. Under these observed conditions, heat waves and extreme maximum and minimum temperatures are expected to become more frequent. Precipitation was the second most frequently analyzed climate variable. The majority of the analyzed articles showed an increase in the prevalence and/or incidence of mosquito-borne diseases due to increased precipitation. Our results support the idea that climate change will threaten the ability of health systems to meet basic needs, including basic physiological and personal safety and security needs, that must be met.

According to the results of our study, 15.15% of health facilities in the Golfe district are affected by the advance of the sea. Also, a proportion of 84.62% of respondents are convinced that there will be a significant advance in sea level in the future. These results are consistent with DCN (2010), MERF (2014–2017), TCN (2015) which indicate that the coastal zone of Togo in general, and that of the Greater Lomé health region in particular, are seriously affected by the retreat of beaches. This statement was confirmed by TCN (2015) which specifies that this retreat varies between 5 and 20 m/year on the coast. On a global level, in the same sense of sea level rise, the study by PASKOFF (1994) came to the conclusion that the majority of the world's coasts are subject to sea level rise.

This study found that the majority of respondents were informed that extreme events will become more pronounced in the future. This could raise awareness among managers and decision-makers to better prepare their health centers to be more resilient to climate risks. Awareness of climate risks also depends on the transmission of information. Thus, the results of our study show that television, technical services and Internet users play a large role in the transmission of climate information. Respondents prioritized climate change as an environmental issue, which is consistent with the notion of environmental stewardship as a widely adopted value in which people act because the environment of health centers is a matter that concerns everyone (Wachter, 2011). Protecting the environmental framework of health centers

is important for excellent motivation of healthcare staff and clients. This study constitutes a tool that will help managers and decision-makers in decision-making against climate risks and their effects in health facilities. The results of our study show that the source of information on the trend of future risks is crucial for the orientation of actions and strategies by decision-makers in combating climate change risks. Referring to the results of our research, all countries must combat deforestation, greenhouse gas emissions recognized as actions that promote climate change to reduce climate risks.

6. Conclusion

This study aimed to analyze the views of health personnel in relation to climate change risks and their effects on health systems in the Greater Lomé health region of Togo. Flooding events, strong winds, drought and rising sea levels are risks linked to this climate variability. The onset of the rainy season is increasingly late or early. This study shows that climate change constitutes a constant threat to public health. In the current context of climate change, there has been a decrease in rainfall, an increase in temperature, the presence of strong winds, floods, rising sea levels and an uneven distribution of rainfall. The results of the study confirm that climate change will increase the risks to health systems in the Greater Lomé health region. Climatic conditions vary in time and space in the Greater Lomé health region. Faced with these variations, it is natural to worry about the proper functioning of health systems because climatic conditions cause several problems.

Our research consisted of administering a questionnaire to health personnel and observing the effects of climate risks. Nearly 45.45% of respondents in the Golfe health district and 78.26% in that of Agoé Nyvé indicate that their health facilities are often flooded. Also, 15.15% of health facilities in the Golfe district are affected by the advance of the sea. A proportion of respondents recognize that drought and floods, respectively 84.62% and 84.62%, will be more severe in the future. This awareness will facilitate decision-making by decision-makers to make health facilities more resilient. Also, it is important to improve, strengthen emergency response capacities, increase energy efficiency and strengthen infrastructure through the construction of water evacuation channels, the cleaning of existing canals. All this information on precipitation, drought and sea level rise indicated above have attested to the manifestation of climate variability. To support health center managers in resilience, information sources must be more diversified and provide more information to raise public awareness of the risks and effects linked to climate change and the actions to be taken.

This research provides important details on climate-related risks and their manifestation in health care facilities in the Greater Lomé Health Region. However, further study is needed to analyze the impacts and strategies put in place to address these different risks in health facilities in the Greater Lomé Health Region. It was noted during this study that not all health facilities are at the same level of vulnerability to the risks encountered in the Greater Lomé health region. Consequently, it appears necessary to rethink compliance with urban planning regulations because these risks can be minimized in health facilities by developing a shared adaptation strategy

between infrastructure managers and those responsible for the territorial planning (Igigabel et al., 2024).

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