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ADAPTATION OF NIGER'S HEALTHCARE SYSTEM TO CLIMATE CHANGE

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ABSTRACT

We live in an era where climate considerations are becoming increasingly significant, particularly those that significantly undermine development efforts. Climate change ranks among the major challenges, and Africa is among the regions most affected. In light of these challenges, adaptation appears to be an absolute priority. This article explores key adaptation measures for the health sector in Niger. Through two complementary analyses (SWOT and DEA), it highlights strategies to respond to immediate crises and strengthen resilience to climate change. The results highlight strengths and opportunities to be seized, including risk awareness, health development planning, the potential for international funding, lessons learned, and best practices at the regional level. However, they also point to threats and weaknesses that hinder the system's performance (only 47%). These are linked to the evolving context of climate change, scientific uncertainty, stakeholders' limited adaptive capacities, and insufficient funding for the sector.

Keywords: Adaptation, Health system, Climate change, DEA, SWOT.

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Introduction

The Intergovernmental Panel on Climate Change (IPCC) published six reports between 1990 and 2023¹, each demonstrating the intensification of climate change. For several years now, climate change has been one of the major global environmental issues (UN, 2023). It continues to influence rainfall patterns strongly, and extreme weather events—which are becoming increasingly frequent and intense—are raising the risk of flooding (PRESASS, 2025).

Recent scientific research has shown that even moderate global temperature increases can lead to more severe climate impacts on societies, including health and health systems (Hoegh-Guldberg et al., 2019). Hachad & Depoux (2021) argue that climate imbalance impacts population health, on the one hand through its effects on natural systems (pollution, water scarcity, food insecurity, etc.) and, on the other hand, through its effects on socioeconomic determinants (access to care, geopolitical conflicts, forced displacement, etc.). According to these authors, these effects result not only in increased mortality from cardiovascular and respiratory diseases and kidney failure, but also in changes in waterborne diseases and the epidemiology of zoonotic and/or vector-borne diseases. According to Vanessa & Mamta (2024)², climate disruption alters the modes of transmission of infectious diseases, making epidemics more frequent and deadly, increasing the risks of heat-related illnesses, exacerbating noncommunicable diseases, deteriorating mental health, and harming maternal and neonatal health. According to these authors, these crises are at the root of the global health emergency, as evidenced by the 2023 thematic day on health at COP28 in Dubai—the first such event at a UN summit (Hensher & McGain, 2020).

These findings, combined with the Paris Agreement’s objective to “enhance adaptive capacity, increase resilience to climate change, and reduce vulnerability to such changes” (UNFCCC, 2015)³, have further raised awareness among health sector leaders of the importance of adaptation measures to address climate change impacts on health⁴. The World Health Organization (WHO, 2023)⁵ states that areas lacking adequate health infrastructure—mostly in developing countries—will be least able to cope without assistance to prepare for and respond to the situation. Within this framework, researchers propose adaptation strategies that place health at the center of the climate crisis. These include, among other things, planning efforts that integrate climate issues, mobilizing substantial resources to transform the healthcare system, and sustaining the involvement of all stakeholders (Hensher & McGain, 2020).

¹ 1990, 1995–1996, 2001, 2007, 2013–2014, and 2023

² <https://blogs.worldbank.org/fr/voices/crise-climatique-et-sante-publique-mondiale> accessed June 25, 2025, at 6:00 p.m. GMT

³ Article 7, page 6

⁴ Climate change directly threatens health, said Dr. Margaret Chan, Director-General of the World Health Organization, on World Health Day in April 2009. “The planet will warm gradually, but the effects of extreme weather events—an increase in the number of storms, floods, droughts, and heat waves—will be sudden and severe. Both of these trends can have repercussions on elements as fundamental to health as air, water, food, housing, and freedom from disease”

⁵ <https://www.who.int/fr/news-room/fact-sheets/detail/climate-change-and-health> accessed June 25, 2025, at 6:00 p.m. GMT

Table 1: Health Impacts of Climate Change

	Climate Change	Health Impacts
Direct	Weather-related disasters	High levels of mortality and morbidity, changes in disease prevalence and types
	Temperature	Heat stress, skin cancer, eye diseases
	Air quality	Cardiorespiratory diseases, allergic disorders
Indirect	Temperature	Food availability, malnutrition, famine, infectious diseases among migrants, droughts
	Precipitation	Waterborne diseases, vector-borne diseases, droughts, food and water availability
	Weather-related disasters (precipitation + temperature + ecosystem)	Diseases among migrants, conflicts, food and water availability, malnutrition, famine
	Ecosystem composition and function	Yields and quality, airborne allergens, vector-borne diseases, waterborne diseases

Source: ClimDev-Africa (2014)

Indeed, like many other impacts of climate change, floods can affect human health and the healthcare system in various ways. According to the World Health Organization (2014), floods can facilitate the transmission of waterborne diseases (cholera, hepatitis A, leptospirosis, typhoid fever) and vector-borne diseases (malaria, dengue, yellow fever, West Nile virus). Because population displacement and overcrowding associated with relocation can increase transmission, diarrheal diseases can be counted among those caused or exacerbated by floods.

In Niger, the main climate-related diseases linked to flooding are malaria, cholera, and other infectious diseases (World Health Organization & Republic of Niger, 2019). Malaria occurs every year with a very high incidence during the rainy season. As for cholera, from 1970 to 2024, the country recorded more than 15 epidemics, with only 4 occurring before 2000. To adapt to the recurrence of climate-sensitive diseases, Niger has adopted several strategies, including ratifying conventions, recruiting health workers, implementing prevention campaigns, providing equipment, creating new centers, and, above all, classifying health districts into high-risk, medium-risk, and epidemic-prone groups⁶.

Given this, what is the current level of adaptation of the health system to climate change in Niger? The main objective of this article is to contribute to expanding knowledge about the shortcomings and efforts made by Niger to best adapt its health system, through two types of analysis: one based on the Strengths-Weaknesses-Opportunities-Threats (SWOT) matrix and the other on Data Envelopment Analysis (DEA).

To achieve this objective, we hypothesize that Niger's health system is insufficient to address the challenges posed by climate change. Specifically, governance frameworks show weaknesses in addressing climate-related health impacts, and the system is also particularly inefficient in managing climate-sensitive risks.

⁶ <https://projects.hpc.tools/project/162332/view>

I- Methodologies

1.1. Strengths, Weaknesses, Opportunities, and Threats (SWOT) Matrix

The SWOT (Strengths, Weaknesses, Opportunities, and Threats) approach is today described as “the proven strategic analysis tool” (UN Women, 2011). It dates back to the 1960s and the work⁷ of Albert Humphrey. According to Panagiotou (2003), the analysis gained widespread popularity in the 1980s, after prominent researchers (Michael Porter, Henry Mintzberg) drew considerable attention to the technique. It is an analytical tool used to make important strategic decisions (Panagiotou, 2003) by assessing the strengths, weaknesses, opportunities, and threats of a system, action, or project. Strengths and weaknesses are internal factors, while opportunities and threats are external or environmental factors (UN Women, 2011).

Insert Figure 1

Figure 1: SWOT Matrix

Source: UN Women (2011)

The SWOT matrix is a simple, effective strategic tool that helps assess internal and external factors and provides a comprehensive overview of the current situation and prospects. Analyzing the strengths, weaknesses, opportunities, and threats of the “health-climate” nexus can inform strategic decisions to implement adaptation measures in Niger effectively and efficiently. By assessing internal (opportunities and threats) and external (strengths and weaknesses) contexts, this tool facilitates and guides useful decision-making regarding the adaptation of Niger’s health system, taking into account the challenges posed by climate change. This proactive approach allows for the exploration of the effectiveness of the Nigerien health system’s adaptation measures to the impacts of climate change by identifying their components. This is a major challenge, as most data is scattered across numerous policy and strategy documents and a wide range of stakeholders are involved (CNEDD, 2020). It enables the identification of health risks linked to climate change and the development of a comprehensive overview of the relevant legal and institutional frameworks.

1.2. DEA Method and Description of Variables

Data Envelopment Analysis (DEA) is a method for assessing the relative efficiency of decision-making units by analyzing a system’s inputs and outputs. Abraham Charnes et al. introduced it in 1978, and Banker, Charnes, and Cooper refined it in 1984 (Coelli, 1996). It is used in various ways to measure a system's performance or efficiency. This method aims to determine the technical efficiency of an organization by optimizing the input-output combinations of a decision-making

⁷ Another version suggests that SWOT analysis originated from case studies at Harvard Business School in the early 1950s.

unit (DMU) using linear programming. In the context of climate change, Jaroslaw et al. (2024) used it to assess the competitiveness of European countries. Regarding healthcare system efficiency, several studies have been conducted, notably by KIMBA GAMATIE (2023) using data from Niger, CHUY et al. (2020) using data from the Democratic Republic of the Congo, Ali et al. (2017) using Ethiopian data, etc. Unlike these studies, which focus on maximizing inputs and cover districts and hospitals, our study focuses on maximizing outputs (the number of recovered patients among admitted cases of climate-sensitive diseases).

The general equation (John, 2006) can be written as follows:

$$Esys_k = \frac{\sum_{j=1}^N u_j Y_{jk}}{\sum_{i=1}^M v_i X_{ik}} \quad (1)$$

$Esys_k$: *efficience technique du système de santé en année k*

Y_{jk} : *quantité d'output j produite en année k*

X_{ik} : *quantité d'input i consommée en année k*

u_j : *poids d'output j*

v_i : *poids d'input i*

N : *nombre d'output*

M : *nombre d'input*

Depending on the research framework and objective, two types of orientation—"input" or "output"—and two types of models emerge (Huguenin, 2013). The first assumes constant returns to scale (CRS), while the second assumes variable returns to scale (VRS). Both types of models can exhibit either orientation.

Our study adopts the hypothesis that the Nigerien healthcare system operates under conditions of variable returns, given the constraints related to shortages of material, human, and financial resources identified in the SWOT analysis. The mathematical formulation derived from the work of Banker et al. (Huguenin, 2013) is as follows.

Programmation modèle VRS

$$\begin{array}{ll}
 \text{Max} \frac{\sum_{j=1}^N u_j y_{jp}}{\sum_{i=1}^M v_i x_{ip}} & \text{Max} \sum_{j=1}^N u_j y_{jp} \\
 \text{S/C} & S / C \\
 \frac{\sum_{j=1}^N u_j y_{jp}}{\sum_{i=1}^M v_i x_{ip}} \leq 1 \quad \forall i & \sum_{i=1}^M v_i x_{ip} = 1 \\
 & \sum_{j=1}^N u_j y_{jp} - \sum_{i=1}^M v_i x_{ip} \leq 0 \quad \forall i \\
 \text{et} & \\
 u_j, v_i \geq 0 \quad \forall i, j & u_j, v_i \geq 0 \quad \forall i, j
 \end{array}$$

ORIENTATION

$$\begin{array}{ll}
 \text{VRS orienté input} & \text{VRS orienté input} \\
 \min \theta & \max \theta \\
 \text{S/C} & \text{S/C} \\
 \sum \lambda_i x_{ji} \leq \theta x_{jp} \quad \forall j & \sum \lambda_i x_{ji} \leq x_{jp} \quad \forall j \\
 \sum \lambda_i y_{ki} \geq y_{kp} \quad \forall k & \sum \lambda_i y_{ki} \geq \theta y_{kp} \quad \forall k \\
 e\lambda = 1 & e\lambda = 1 \\
 \lambda_i \geq 0 \quad \forall i & \lambda_i \geq 0 \quad \forall i
 \end{array}$$

ou

θ est le score de l'efficacité de DMU p

λ_s représente l'efficacité maximale (benchmarking)

e est le vecteur unitaire

λ est le vecteur poids

We use this method to analyze efficiency—that is, the Nigerien health system's adaptation to climate change. The input factors are derived from precipitation data collected at various stations nationwide and the Environmental Performance Index⁸, calculated using data from the Yale University website. Other inputs include variables measuring the healthcare system, such as the number of healthcare facilities of all types⁹ and the number of healthcare personnel (doctors, nurses, etc.). The number of flood victims supplements these data. As with the inputs, we identified

⁸ Environmental Performance Index (Ecosystem Vitality, Environmental Health, Climate Change Policy Objective) from <https://epi.yale.edu/>

⁹ The data comes from the statistical yearbooks of the Ministry of Health. This includes personnel and hospitals, districts, integrated health centers, health posts, etc. (INS Niger, 2025)

six (6) climate-sensitive diseases commonly recorded in Niger using the Ministry of Health's statistical yearbooks. We calculated the number of recoveries as the difference between recorded cases and deaths, which constitutes the model's output.

Table2: Input/output selection for the DEA-VRS model

Inputs	Outputs
Health infrastructure (infra_ep) Number of treating physicians (med) Number of other healthcare staff (p_soins) Environmental performance index (epi) Average annual precipitation (precipitation) Number of flood victims (aff_inond)	Number of recovered cases of climate-sensitive diseases among recorded cases (recovered_csd)
6	1

Source: authors

This model aims, based on annual inputs, to maximize the number of people cured of climate-sensitive diseases admitted to health centers. All data were standardized using min-max normalization.

II- Results

2.1 Health System Governance in the Face of Climate Change

The analysis of the health governance system in the context of climate change includes a review of relevant texts, conventions, and measures that can lead stakeholders to a collective commitment and rigorous oversight. Indeed, the regular cycle of floods, followed by climate-sensitive diseases, has led authorities and their partners to take decisive action on climate issues. To this end, several strategic options and relevant platforms have been developed and implemented to prioritize the most appropriate adaptation measures to reduce the impacts of climate change on health, as highlighted in the fourth report ¹⁰ (CNEDD, 2024). In terms of system strength, the measures taken emphasize integrating climate change into the health sector and strengthening its resilience to climate risks. This involves strengthening the health system's resilience to cope with climate-related threats. To this end, reference frameworks have been developed (see appendix) at both the international and national levels to adapt Niger's health system to the impacts of climate change, including the health impacts of floods. These frameworks acknowledge the climate shocks affecting the health sector and propose a range of general and specific adaptation solutions.

¹⁰ Consider establishing a meteorological monitoring and warning system; Assess vulnerability and adaptive capacity by region, community, and population group; Examine factors influencing current adaptive capacity, including physiological, psychological (knowledge, beliefs, attitudes), and socio-economic factors, as well as characteristics of the health system; Gradually implement biological and health monitoring measures as a means of adapting to climate change; Select the most appropriate climate change strategies and adaptation measures; continue research, particularly interdisciplinary studies.

Regarding the international legal framework, Niger signed and ratified the United Nations Framework Convention on Climate Change (UNFCCC) on June 11, 1992, and July 25, 1995, respectively, followed by the Kyoto Protocol on October 23, 1998, and ratified on September 30, 2004, as well as the Paris Climate Agreement on April 22 and ratified on September 21, 2016. In addition, regional commitments include the African Union's (AU) Agenda 2063 and the West African Economic and Monetary Union's (UEMOA) Vision 2040.

At the political and strategic levels, the country's commitment to climate change adaptation—particularly in the health sector—is reflected in several policy frameworks. These include the National Climate Change Policy (CNEDD, 2012), which provides the framework for climate action; the National Adaptation Plan¹¹; the Nationally Determined Contribution; and, more recently, the country's commitment to developing the Resilience Program for the Safeguarding of the Homeland (Republic of Niger, 2024). Within these frameworks, several instruments that contribute to strengthening the health system can be cited as opportunities, such as the Niger 2035 Strategy for Sustainable Development and Inclusive Growth (Republic of Niger, 2017); the Economic and Social Development Plan (PDES), the National Strategy for Disaster Risk Reduction (SNRRC)¹², the 2030 Agenda and the seventeen (17) Sustainable Development Goals that stem from it, and the various National Communications¹³, among others. In addition, other relevant documents exist and serve as a basis¹⁴ for adapting Niger's health system to the impacts of climate change. At the institutional level, a multitude of structures contribute to implementing established frameworks to facilitate the health sector's adaptation to the impacts of climate change in Niger. Likewise, several Technical and Financial Partners (TFP)¹⁵ are helping to strengthen health systems, and the Global Fund's recent launch of the Climate and Health Catalytic Fund to accelerate global action comes at just the right time.

¹¹ Submitted to the UNFCCC in November 2022.

¹² Through projects such as *the Disaster Risk Management and Urban Development (PGRC/DU) project, the Climate Change Adaptation, Disaster Prevention, and Agricultural Development for Food Security (ANADIA) project, the African Disaster Risk Management Financing Program (ADRFi) in Niger, and the Project to Strengthen Disaster Risk Reduction and Adaptation Capacities in Support of Resilience in the Sahel Region (AdCom, Niger, 2024).*

¹³ Niger submitted its Initial National Communication (INC) to the Sixth Conference of the Parties (COP6) to the UNFCCC in November 2000 in The Hague (Netherlands); the Second National Communication (SNC) was submitted to the Fifteenth Conference of the Parties (COP15) in December 2009 in Copenhagen (Denmark). As for the Third National Communication (TNC), it was submitted to the Twenty-Second Conference of the Parties (COP22) in Marrakesh (Morocco).

¹⁴ The Constitution of November 25, 2010, which has been suspended, stipulates in Article 35 that *“every person has the right to a healthy environment. The State has the obligation to protect the environment in the interest of present and future generations. Everyone is required to contribute to the preservation and improvement of the environment in which they live...”*

¹⁵ The Agricultural Bank of Niger, which is accredited to the Adaptation Fund (AF), the World Bank, the African Development Bank (AfDB), the International Fund for Agricultural Development (IFAD), the Bank of West African Development (BOAD), the Bank of the Islamic Development Bank (BIDC), the French Development Agency (AFD), the European Union (EU), the Food and Agriculture Organization (FAO), the United Nations Development Programme (UNDP), the World Food Programme (WFP), the Islamic Development Bank (IDB), the Arab Bank for Economic Development in Africa (BADEA), German cooperation (GIZ), Chinese cooperation, Swiss cooperation, Belgian cooperation, the West African Economic and Monetary Union (UEMOA), the Japan International Cooperation Agency (JICA), and the Economic Community of West African States (ECOWAS).

However, despite these efforts, challenges remain. These challenges highlight the weaknesses of the health system, at a time when climate risk forecasts (PRESASS, 2025) predict an increase in the frequency and intensity of extreme events, such as the exceptional flooding of the Niger River in 2012, 2020, and 2024, which caused 182, 166, and 396 deaths, respectively, and affected more than 2.6 million people in those years alone¹⁶. For this reason, an efficiency analysis using the DEA method was conducted to complement the SWOT matrix assessment.

2.2 Efficiency of the Health System in Addressing Climate-Sensitive Diseases

An analysis of Niger's health system in the face of climate change reveals that, in most cases, water contamination amplifies risks. This is why most of these diseases break out in rural areas where access to drinking water is virtually nonexistent. Additionally, poor-quality border health systems encourage people to move to seek care, thereby facilitating the spread of disease. According to Yacouba Moustapha et al. (2023), climatic factors play a significant role in the recurrence of epidemics in Niger. These authors observed a statistically significant relationship between humidity and the recurrence of cholera epidemics in Niger. To address this, Elh Ibrahim (2021) distinguishes between restart factors (cross-border movement with countries regularly affected) and amplifying factors (hygiene conditions, sociocultural factors, overcrowding, flooding, lack of drinking water, etc.). Other studies explain that as climate conditions change, intense meteorological and climatic phenomena are observed, with direct and indirect effects on the health system, increasing the risk of death, noncommunicable diseases, the emergence and spread of infectious diseases, and health emergencies (World Health Organization, 2023). For this reason, we are seeing a cascade of diseases, along with an increase in known diseases and/or the (re)emergence of others in various forms.

Insert Figure 2

Figure 2: Trends in the percentage of deaths from climate-sensitive diseases and floods

Source: authors

¹⁶ (DGPC Niger, 2025).

Deaths related to climate-sensitive diseases have shown varying trends in relative percentages and in the early 2000s, measles, meningitis, and diarrhea accounted for a high relative percentage. In recent years, however, cholera, diphtheria, and malaria have recorded the highest number of cases and deaths as a percentage. In terms of the number of reported cases, malaria is by far the most prevalent disease, with over 63 million admissions to healthcare facilities between 1998 and 2022. Nevertheless, in terms of case-fatality rate, meningitis ranks first at 75.15 per 1,000, followed by diphtheria (67.05 per 1,000), cholera (30.08 per 1,000), measles (6.64 per 1,000), malaria (1.11 per 1,000), and, finally, diarrhea (0.96 per 1,000).

Individual analyses show that meningitis and measles decreased during the study period. In contrast, malaria, cholera, and diphtheria increased in parallel with the number of flood victims. This demonstrates that in Niger, climate change is associated with increased flooding and waterborne diseases.

Adaptation through equipment acquisition is assessed by analyzing the cumulative series of flood victims and the trend in the number of inhabitants per hospital bed. The latter reveals an improvement effort that falls short of the challenges. Indeed, the relative proportion of flood victims among cases of climate-sensitive diseases is approximately 6%, while the relative proportion of the population among cases of climate-sensitive diseases is 4.5%. Furthermore, over the study period, more than 2.8 million cases of climate-sensitive diseases and more than 157,000 flood victims were recorded each year on average. Faced with this situation, response capacity has unfortunately fallen short, as on average, more than 66,000 residents must make do with a single hospital bed if they fall ill. This highlights the gap between the needs created by the consequences of climate change (diseases, floods, etc.) and the capacity to address them.

The analysis also shows that the environmental performance index has improved, albeit slightly, due to a proactive climate change adaptation policy during the study period.

Insert Figure 3

Figure 3: Trends in flood victims and the number of hospital beds per capita

Source: authors

The input-oriented VRS model served as the analytical framework for our data from 1998–2022. This choice stems from the fact that we have greater control over inputs than over outputs. Indeed, the state, as the decision-maker, has greater capacity to influence infrastructure, personnel, and activities related to flood and waterborne disease prevention, but above all, its policies regarding climate change. By controlling these factors, the decision-maker can indirectly influence the output—in our case, the number of patients recovered from climate-sensitive diseases admitted to healthcare facilities.

Thus, the results of the two-level envelopment analysis reveal a significant gap compared to the maximum efficiency (benchmark). In fact, all decision units (years) in our sample were inefficient, despite the relative performance of 2013 and 2020, as all exhibit increasing returns to scale (IRS). Only these years were on the efficiency frontier. The year 2002 was the worst in terms of healthcare facility efficiency, as the number of patients cured of climate-sensitive diseases that year could have been achieved with 96% fewer government resources invested. Overall, the analysis shows that the results in terms of curing climate-sensitive diseases among patients admitted to health facilities could be achieved with 53% fewer resources invested. In other words, all else equal (*ceteris paribus*), health facilities are barely half (47%) as efficient as ideal efficiency relative to government investments. This indicates that it is possible to achieve greater adaptation outcomes with current resources. To support our analysis, we ran a Tobit regression on the second-level residuals. The results show a positive, statistically significant relationship at the 1% level between efficiency and the number of cases cured of climate-sensitive diseases. Thus, a change in the efficiency of health facilities leads to a 0.55-point increase in the number of people cured. In other words, a 10% adaptation effort by the Nigerien health system to climate change could help protect approximately 6 people from climate-sensitive diseases.

Table 3: Censored regression results

VARIABLES	(1) Efficiency	(2) /
cured_mcs	0.551*** (0.181)	
var(e.Efficiency)		0.0472*** (0.0158)
Constant	0.257*** (0.0862)	
Observations	21	21

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Source: authors

III- Discussion and Conclusions

All countries have developed robust strategies, particularly in Niger, to adapt to the impacts of climate change. These strategies primarily target the most affected sectors, including the health sector.

In this regard, several measures have been taken to strengthen the monitoring of risk factors associated with extreme weather events, which are exacerbated by the lack of available resources in Niger. As evidenced by the SWOT assessment, the country has made efforts to integrate health into climate policies. The four national communications submitted by the country identified the health sector as one of the most vulnerable to climate change. However, this is not the case in certain key documents, such as the revised national contribution. As a reminder, this vulnerability in Niger manifests itself both directly and indirectly, driven by ecological and environmental upheavals resulting from global warming. Furthermore, the National Adaptation Policy identifies three (3) priority adaptation options. These are broken down into twelve (12) adaptation projects, with point ten specifically addressing the fight against climate-sensitive diseases. The Analysis confirms the series of measures identified as best for adapting Niger's health system to the impacts of climate change. These measures¹⁷ include, among others:

- the proposal to establish a health surveillance and weather warning system that would enable continuous data analysis and improve the prevention system;
- the mobilization of additional financial resources for adaptation measures in vulnerable health zones;
- the continuation of multidisciplinary and transdisciplinary research to identify further effective adaptation measures for the health sector in the face of climate change; and
- the promotion of an interdisciplinary and inter-institutional partnership aimed at strengthening the health system's resilience to climate change.

Niger's commitment to adapting its health system to climate change is evident through various strategies and ongoing investments. These existing frameworks, however, are limited by the absence of a national plan for the health sector's adaptation to climate change, which could have served as a foundational framework for better management of health crises linked to extreme weather events, including floods in Niger. Furthermore, the health system's poor performance hinders adaptation efforts, as evidenced by the envelopment analysis of the data. Despite proactive measures to address the adverse effects of climate change, climate-sensitive diseases and significant losses continue to rise. This is why new approaches complementary to existing frameworks must be considered to promote meaningful adaptation.

Thus, looking ahead, capacity building and substantial funding must be put in place. It is also important to encourage research to improve understanding of the health risks associated with climate change and, above all, the economic costs.

¹⁷ They are also highlighted in Niger's Fourth National Communication, which calls for the establishment of early warning systems for epidemiological risks and response plans that incorporate climate determinants, as well as the strengthening of the surveillance system for climate-sensitive diseases by integrating environmental and climate considerations.

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Conflicts of Interest

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- Not applicable

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- Not applicable

Authors contribution declaration

- **Dr. Habou ISSA**

Conceptualization, Investigation, Writing - original draft, Methodology, Validation, Writing - review & editing, Software, Formal analysis, Data curation

- **Nana HAROUNA MAHAMADOU**

Conceptualization, Investigation, Writing - original draft, Methodology, Validation, Writing - review & editing.

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	National frameworks to address the health impacts of floods
Policies and strategies	National Strategy and Action Plan on Climate Change and Variability (SNPA/CVC), 2004
	National Action Program for Adaptation to Climate Change (PANA), July 2006
	National Environmental Plan for Sustainable Development (PNEDD), 2016
	National Strategy for Disaster Risk Reduction (SNRRC 2019–2030)
	National Climate Change Policy (PNCC), 2020
	Study Report on Vulnerability and Adaptation to Climate Change in the Health Sector, 2020
	Revised Nationally Determined Contribution (NDC), 2021
	National Strategic Plan to Improve Access to Water, Hygiene, and Sanitation Services in Health Facilities, 2022–2026
	National Climate Change Adaptation Plan (NCA), 2022
	Updated Biennial Report (RBA), 2022
	Climate Change Communication Strategy (SCCC),
	Strategy for Sustainable Development and Inclusive Growth (SDDCI) Niger 2035
	National Strategy and Action Plan on Climate Change and Variability (SNPA/CVC),
	Health and Social Development Plan 2022–2026
	First Communication on Adaptation (AdCom) to Climate Change in Niger, 2024
	Fourth National Communication on Climate Change, 2024
	Resilience Program for the Safeguarding of the Homeland (2024–2026),
Legal and Regulatory Framework	Ordinance No. 93-015 of March 2, 1993, establishing the guiding principles of the Rural Code.
	Law No. 98-56 of December 29, 1998, establishing the framework law on environmental management in Niger
	Law No. 2001-32 of December 31, 2001, on the Guidelines for Spatial Planning Policy
	Law No. 2017-06 of March 31, 2017, establishing the fundamental principles for the organization of civil protection
	Law No. 2018-28 of May 14, 2018, establishing the fundamental principles of environmental assessment
	Decree No. 30/PM of February 9, 2012, establishing the National Platform for the Reduction of Natural Disaster Risks, its functions, and its composition
	Decree No. 0170/MISP/D/ACR/SG/DGPC of March 1, 2016, approving the National Risk Analysis and Coverage Plan
Institutional Framework	The National Council for the Environment and Sustainable Development (CNEDD) was established by Decree No. 96-004/PM of January 9, 1996, amended and supplemented by Decrees No. 2000-272/PRN/PM of August 4, 2000, and 2011-57/PCSRD/PM of January 27, 2011.
	National Mechanism for the Prevention and Management of Food Crises (DNP-GCA)
	General Directorate of Civil Protection (DGPC)
	Directorate of Environment and Disaster Risk Prevention
	The Directorate of Epidemic Surveillance and Response is responsible for the prevention and management of epidemics throughout the country
	“One Health” Committee in 2019
	National Focal Point for the African Transformative Alliance on Climate and Health (ATACH)

	Climate/Health Working Group led by the National Meteorological Directorate (DMN), including the publication of health alert bulletins and the establishment of three (03) automatic air quality monitoring and assessment stations in 2022
	Center for Education and Research on Health and Climate Change (CERSCC-MAGARIA), 2022

SWOT Health-Climate Matrix in Niger

	Positive	Negative
	Strengths (internal capabilities)	Weaknesses (internal limitations)
Internal	Awareness of health risks related to climate change Health development plans Existence of frameworks for addressing health impacts related to climate change Integration of health into climate policies	Lack of a national adaptation plan for the health sector Limited resources Need for capacity building Difficulties in accessing data
	Opportunities (positive external factors)	Threats (challenges/limiting external factors)
External	Existence of regional and international frameworks Feedback and best practices on managing the health impacts of climate change at the regional level Application of artificial intelligence International financial opportunities	A changing context (evolving climate change) Scientific uncertainties

Figure Page 5

Figure 1: SWOT Matrix

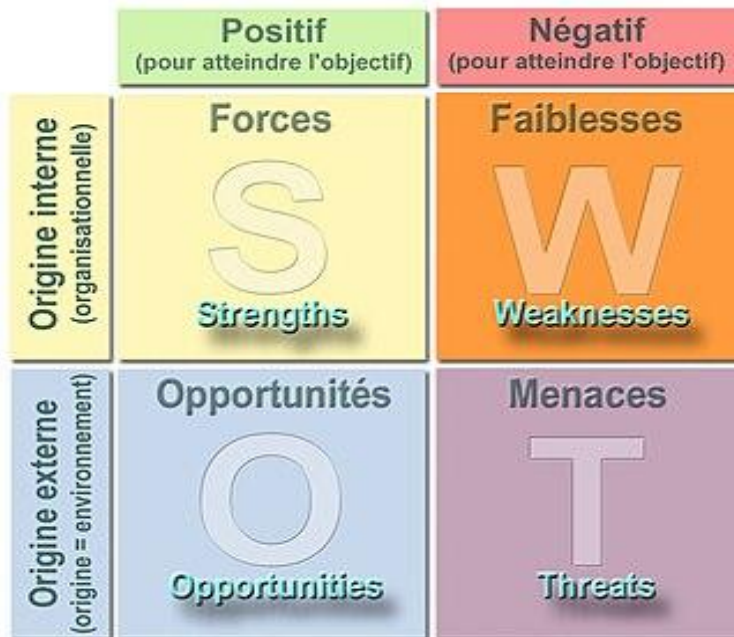


Figure Page 11

Figure 2: Trends in the percentage of deaths from climate-sensitive diseases and floods

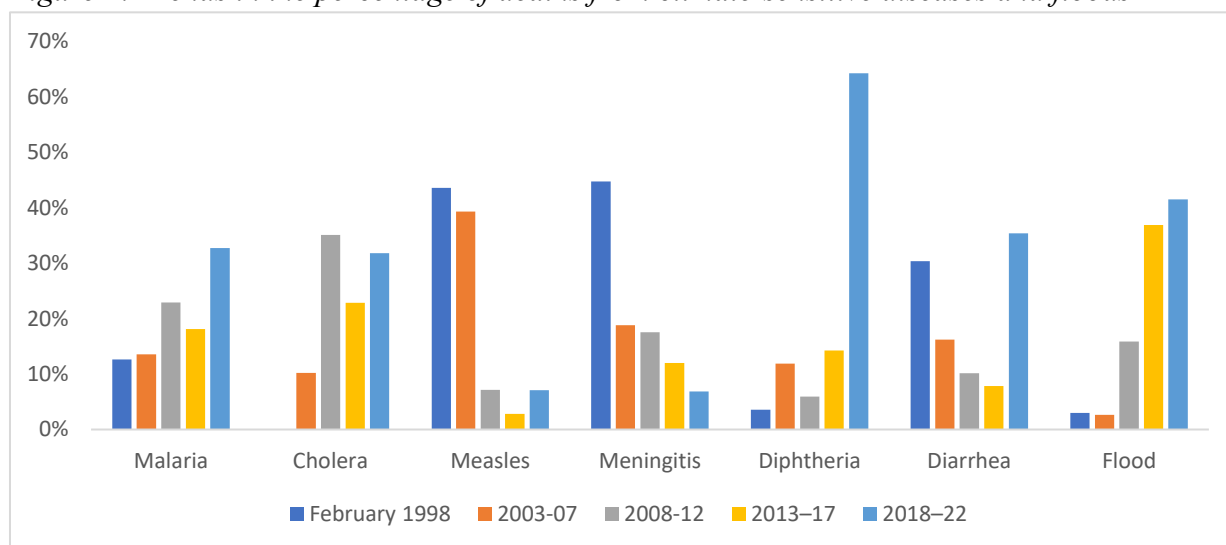
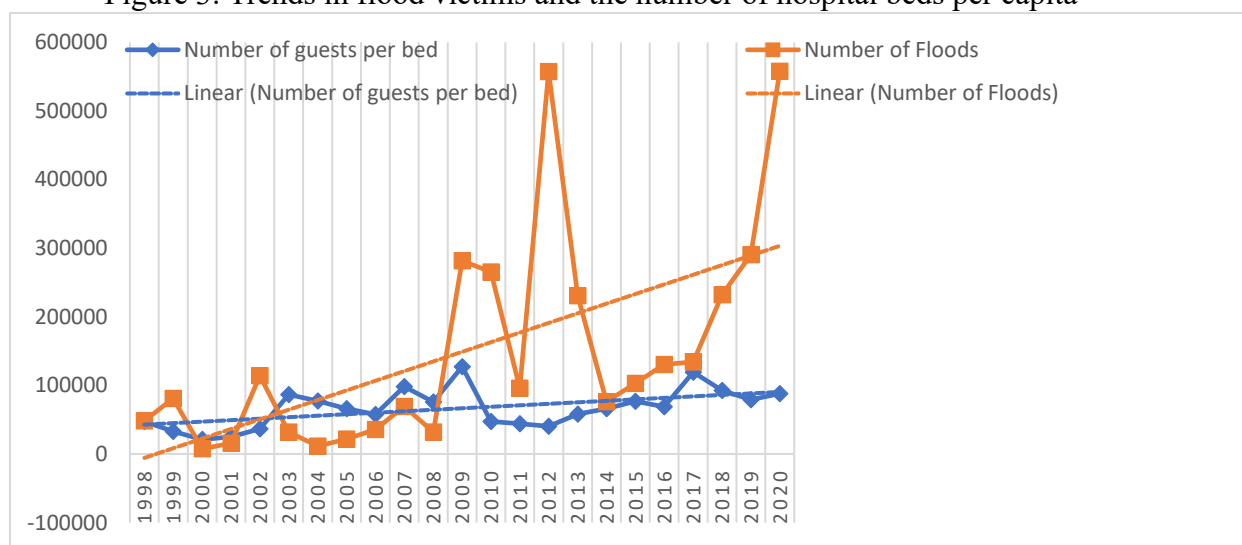


Figure Page 12

Figure 3: Trends in flood victims and the number of hospital beds per capita



Supplementary Files

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- [Dataavailabilitystatement2.docx](#)