

Impacts of Climate Change on Public Health: A Retrospective Analysis from the Example of the Niger Republic

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Abstract: *Climate change is a social phenomenon causing several environmental upheavals likely to exacerbate health risks. This phenomenon promotes the appearance or reappearance of multiple infectious diseases, the increase in the frequency and intensity of extreme climatic events, profound changes in the environment and serious health consequences.*

This article comprehensively analyzes the consequences of climate change on human live conditions and public health in Niger. The available scientific data indicate that climate change favors the outbreak and multiplication of diseases in the world and particularly in developing countries. The repetitive frequency of climatic hazards affects the health of the population and amplifies their health and socio-economic vulnerability. Niger is a country plagued by climate change in all its dimensions. Its population is traditionally exposed to multiple diseases, some of which are undoubtedly due to the consequences of climatic hazards.

These recurring natural disasters observed in recent years are the result of climate change and these naturally affect public health from several angles. Thus, under these climatic threats and their consequences on the health and quality of life of the population, new diseases are very often observed and are spreading at an accelerated rate. This complex social situation does not leave indifferent the indigenous populations and the researchers who are trying to find answers to the various questions posed.

Thus, this article analyzes and discusses the various impacts of climate change on public health and presents recommendations likely to reduce contamination with diseases linked to climate change. These diseases linked to climate impacts are structured around elements such as malaria, cholera, infections, depression, meningitis, tuberculosis, asthma, colds, etc. These represent most of the diseases recorded in Niger.

I. Introduction:

Climate change is one of the most complex current events that the whole world is facing and looking for ways and means to address it. This is a global issue that affects the quality of life and well-being of the population. For this reason, it is necessary to question the role that climate change plays in the continued degradation of human health.

In West Africa, and particularly in the Sahel area, climate issues are raising increasingly serious and legitimate concerns, as people are witnessing the appearance of new forms of diseases that were previously unknown to the general public. In this region, the climatic manifestations are particularly severe and destructive than in the rest of the world. These multiple and multifaceted consequences of climate change exacerbate disease. Moreover, under the combined effects of climate change in the Sahel, agricultural and livestock lands are degrading and losing more of their productivity. These recurrent natural disasters have a natural effect on the various components of public health. These climatic manifestations clearly contribute to the deterioration of health through several mechanisms. Thus, in view of these climatic threats and their consequences on the health and quality of life of the population, new diseases are very often observed and spread easily depending on the context.

So therefore, in our today's life many diseases and public health related issues are linked to climate change effects. This article highlights how climate change effects can exacerbate some public health issues. This article is also a test to highlight, inform and educate the population about the impacts and dangers of climate change effects in relation to public health. To promote good health practices in correlation which successful climate change adaptation measures.

II. Method

For the purposes of this article, the qualitative research method was used. To better understand the issue in its diversity and obtain qualitative information related to climate change and public health in Niger, emphasis was placed on the qualitative approach through semi-structured in-depth interviews and document analysis. The complexity of the effects of climate change and the analysis of the problems surrounding public health make it very necessary to use this method of analysis.

Indeed, the basic principle of qualitative research is to understand in depth the object studied according to the dimensions that characterize it, the information on the main phenomena explored, as well as the participants and the places of research. At this level, qualitative data analysis is a process of specific research and systematic compilation of data obtained from interviews, field notes and available documentation, organizing the data into categories, describing them in units, synthesizing them, compiling models, choosing those that are important, less important and relatively important, in order to draw all possible conclusions to make understanding easier. It is for all these reasons that the qualitative data analysis technique was used to analyze the data on the impacts of climate change on the health of the population.

III. Background

3.1. Impacts of climate change on public health

Climate change is causing multiple environmental upheavals that can exacerbate health risks around the world. Indeed, the various impacts due to climate change favor the development and spread of infectious diseases, the increase in frequency and intensity of extreme climatic events, profound changes in the environment and the serious health consequences they generate.

Jim Yong Kim, President of the World Bank Group remarks at Climate Action Summit 2016 "Climate change threatens our fragile existence on this planet". For Margaret Chan, World Health Organization "For public health, climate change is defining the major challenge of our century".

According to Costello et al. (2009), climate change will affect most of the population over the coming decades, posing additional risks to the lives and well-being of billions of people. For IPCC, "climate change is expected to increase health risks". Rather than environmental and economic damage, climate change is wreaking havoc between our most precious resources, people and their health. In this context, according to the United Nations Framework Convention on Climate Change (UNFCCC, 1992), one of the three main "adverse effects" of climate change is its impact on human health and well-being. Climate change therefore has a dramatic impact on health. Thus, small changes in temperature and precipitation can increase the frequency of vector-borne diseases such as malaria, dengue, and yellow fever, and water-borne diseases such as diarrhea and typhoid fever. Moreover, climate change encourages human mobility which will lead to the spread of sexually transmitted diseases such as HIV and AIDS (Gemenne, 2009 and ADF, 2010).

For Pachauri and Reisinger (WHO, in 2016), climate change can affect health through a variety of mechanisms, including in part the direct effects of phenomena such as heat waves, floods and storms. Climate change affects health in a more complex way through changes in the epidemiology of infectious diseases, the degradation of agro-ecosystems and other supporting ecosystems. Also, due to the scarcity of resources such as water, fertile land and fishing, population displacements or conflicts affect health.

For Rosa and Marcela (2012), climate change also has a major impact on human health. Water-borne and vector-borne diseases for example malaria and so many others heat-related illnesses are on the rise due to climate change. Malnutrition and air pollution exacerbate these diseases and cause other illnesses such as

asthma or allergies. This difficult state can also lead to mental disorders such as anxiety or depression, Zirz said. Those most vulnerable to health risks are pregnant or breastfeeding women, children and the elderly. In disaster areas, these people are more vulnerable as the lack of health, immunization, family planning and reproductive health services increases. This lack of care can be the cause of an increase in maternal and infant mortality rates. However, emergency shelters very rarely provide health services and supplies to women and children.

For Andrew K. Githeko et al. (2000), the tropical climate of Africa is favorable to most major vector-borne diseases such as malaria, *schistosomiasis*, *onchocerciasis*, *trypanosomiasis*, *filariasis*, *leishmaniasis*, plague, fever of Rift Valley, yellow fever and tick-borne hemorrhagic fevers. This continent has a great diversity of vector species complexes that have the possibility of redistributing themselves in new habitats depending on the climate, which can lead to a new distribution of diseases. These organisms have variable sensitivity to temperature and precipitation.

3.2. Climate change extreme events

The living environment of human is threatened by some climate change extreme events that endangers survival in term of health and food security. Indeed, these extreme climatic events shape human life in many ways.

3.2.1. Water scarcity problems

Drought is an effect of climate change that brings water scarcity problems. The lack of water affects human and their health and their activities. The water scarcity posed by drought as an effect of climate change can lead human to the use of the dirty water for their needs, that induces severe diseases such as cholera, dysentery etc.

Indeed, climate impacts in Niger make the availability and accessibility of water difficult, especially drinking water. In this country, of which 77% of the territory is desert and about 200,000 hectares are lost each year due to multiple climatic events and the degrading climatic situation, forces a large part of the population to consume water from ponds, backwaters, lakes, wells and the river despite the health consequences that this can cause. In some localities of the country, millions of people agree that the water found there is simply "edible", it is not "drinkable" according to the standards established by the WHO (CNEDD, 2005). This unsanitary water widely consumed by the population is not without health consequences. It is the basis of many diseases and it is especially women and children who suffer the most, unfortunately. It is estimated that approximately more than 6,000 children die each year in Niger from diarrhea caused by the consumption of unsafe water. About 64% of Niger's rural population does not have access to clean, safe and drinkable water. The consumption of this unhealthy water promotes the development of multiple and multifaceted diseases. This situation leads to diseases, slows down education and economic growth and is responsible for maternal and infant mortality, especially in rural areas (UNICEF, 2006).

In this Sahelian country, diseases caused by water and the negligence of some rules of hygiene and sanitation are the fundamental sources of the death of children whose age varies between zero and five years. The availability of safe drinking water is still very low in this country and above all the gap is enormous between the cities and the countryside. Thus, approximately 56% of the citizens of this country have access to drinking water with an increase of approximately 7% between 2012 and 2015. In addition, we note that only 13% of the population benefits from the services of basic sanitation. Some social or even natural needs such as defecation are done in the open air by about 71% of the population. This situation has enormous consequences in terms of health, nutrition, education and the socio-economic development of the country (UNICEF, 2013).

However, Niger is also an arid land, on the edge of the Sahara, and droughts are frequent. The impacts of climate change on precipitation are enormous and groundwater must provide the vast majority of the country's drinking water. This traditional source of water supply is not without consequences on the health of the population. Dug wells are generally traditional and therefore susceptible to contamination by infiltration of waste or other types of contamination.

In this country with a high birth rate, water needs are enormous. However, water is indeed a scarce commodity and generally of poor quality. This scourge generates enormous difficulties in everyday life mainly. Climate change through the various natural disasters they cause (especially desertification and scarcity but also

insufficient rainfall) are not so many aggravating factors that need to be considered. On the other hand, the lack of water generates profound imbalances in the daily life of the population and further reinforces the social inequality between rich and poor, city dwellers and people who live in rural areas, between men and women (INS, 2012).

Thus, many communities are condemned to drink the same water as their animals in order to survive. This undrinkable water contains bacteria that are extremely dangerous to human health. However, the people interviewed are unanimous on the fact that, despite the unsanitary nature of this water, it still constitutes water and, moreover, the water available in especially rural areas. It is for all these reasons that people consume this water without showing regrets and worries. The words of this breeder are quite illustrative: *We consume the water we find because we have no other choice. The concern of all the populations of this area is how to find water throughout the year. It does not matter whether it is drinkable or not, the main thing is that it is water.*



Source: Ajepaz (2016)

3.2.2. Flooding

Flooding is one of the climate change extreme events. The climatic situation in Niger has enormous consequences for the populations. Multiple floods are observed each year in all regions of the country. Indeed, the succession of floods has been occurring especially in the Niger River area for several years now. According to Thierry Lebel et al (2018), the succession of these deadly floods are the consequences of the combination of the increase in the volume of precipitation due to climate change and the changes observed in the continuing degradation of the land. The explosion of demography in this country, the continuous deforestation, the non-set aside of land and rapid urbanization combine to reduce the water absorption capacity of the soil, particularly throughout the Sahelian region.

Flooding events affect human, their habitats as well as their health specially with the spread of mosquitos in stagnant water causing high risks of incidence of malaria. Every year, several thousand people are infected with the malaria vectorial virus in Niger. Malaria is one of the most dangerous public health problems facing the population of Sub-Saharan Africa. Indeed, in the words of the Nigerien Minister of Health Dr. Idi Illiassou

Mainassa: *“In Niger, the year 2020 is marked by an increase in cases of malaria following exceptional rainfall which caused flooding, water stagnation and the proliferation of mosquito vectors of malaria” (ANP, 2019).*

These torrential rains that fall on the country cause floods that are often the most dangerous possible. These floods make populations vulnerable in terms of health through malaria crises and the cholera epidemic. This common disease in Niger is very dangerous and causes several dozen deaths each year. Indeed, it must be said that malaria is a disease with a high mortality rate that is rampant in African countries and Niger is not spared. This disease, which rhymes with the rainy season, does enormous damage in this winter period with a very high rate of contamination. This situation is explained by the fact that the rainy season is marked each year by floods and by the fact that mosquitoes thrive in stagnant water.

Floods have become a daily occurrence for the entire population of Niger, a local resident confidesus. Years pass and things become more and more routine and very complicated. And these floods are not without consequences on health, because the epidemic of malaria and even that of cholera wreak havoc every year. This stagnant water becomes a reservoir for mosquitoes and other viruses responsible for various diseases. The deaths are counted in the thousands each year, mainly from malaria.

Also, after these episodes of flooding, the contamination and the increase in the number of cases of cholera and urinary schistosomiasis each year multiply. Children and even the elderly are in contact with unhealthy or even contaminated water, which increases the health risks. Thus, the participants in this research, unanimously affirm that the climatic changes observed in recent years negatively affect their health through the multiplication of new diseases but also the aggravation of forms of already existing diseases.

Moreover, apart from its short duration, of three months maximum, and the low rainfall, the rainy season has been regularly deadly for several years, including in areas where the rains are usually rare. A paradox in this country where poor harvests are usually due to drought, these consequences negatively affect the health of the population.



Source: Kane, I. (2021)

3.2.3. Climate Change, Fossil Fuel and Public Health

Fossil fuel and all burnings lead to CO₂ production that lead to global warming and environmental air pollution. Global warming lead to climate change with its effects that endanger our health security and condition and air pollution can respiratory diseases.

Air pollution has invaded the cities and the countryside in Niger. It is more than necessary to take into account the state of physical and mental health, age, destination, duration when traveling and the season when visiting the northern and northeastern regions, to mitigate the effects of air pollution. The burning of fuels allows the emission of air pollutions that are emitted by the combustion process. Pollution from heating is added to that of transport and industrial activities at all levels. Depending on their concentrations in the air and the sensitivity of people, they can cause acute attacks (respiratory distress, cardiovascular accident, stroke) or chronic diseases (lung disease, asthma, hypertension, heart disease and vascular, cancer). The respiratory tract is affected by fine particles, nitrogen oxides, ozone and sulfur dioxide. The cardiovascular system by ultra-fine particles, nitrogen oxides and carbon monoxide.

The immediate consequences of increased air pollution revolve around the appearance of itching in certain parts of the human body such as the eyes, nose and throat. It also causes other symptoms such as wheezing, coughing, shortness of breath, chest pain, headache, nausea, and upper respiratory infections (bronchitis and pneumonia). This situation is the basis of the explosion of asthma and emphysema. Over time, the impacts caused are, among others, lung cancer, the increase in cardiovascular diseases, chronic respiratory diseases and the development of repetitive allergies. The pollution of the air and the natural environment in this area is also, according to experts, at the root of the heart attacks and strokes recorded in recent years. The testimony of this health worker is quite illustrative: *air pollution is a health problem in Niger. Unfortunately, Niger is a country where pollution is very high and the conditions for resilience are not always adequate. Many illnesses are caused by pollution, but since investigations are still not made, the degree of involvement of pollution in the public health problem is very often unknown.*

3.2.4. Strong Winds and Public Health

When climate change, we can have violent and strong winds currying along all kind respiratory diseases parasites, and the alternative is to be protected against dust.

Climate change manifests itself through several very often catastrophic events. The strong winds caused by climate change cause health, material and often life-threatening damage. This nurse explains the situation in these terms: *"Dust raised by winds contains pathogens such as viruses, bacteria, fungi as well as toxic substances that can cause certain diseases such as asthma, a high percentage of the population has symptoms or have asthma attacks. The flu is also very prevalent especially after the winter season. Indeed, dust can complicate certain diseases such as sinusitis"*.

Manifestations of climate change favor the development of characteristics that can seriously harm human health. Among these manifestations we can note dust, which contains pathogens such as viruses, bacteria, fungi as well as toxic substances that can be the cause of certain diseases such as asthma, flu.

In Niger almost every year huge sandstorms over several cities in the country turn the sky a deep crimson red as a towering wall of dust swept across the sky creating an awe-inspiring spectacle. The immense storm shrouds the cities in an eerie reddish darkness. This climatic situation plays a key role in the contamination and rapid spread of certain diseases.



Source: Issa, M. (2020)

3.2.5. Industrialization and Public Health

As industrialization, the transport sector pollutes the environment as well as it contributes to climate change. In the Nigerien context, the rapid process of industrialization and high standard of living, the reduction of leisure hours and the industrial techniques in progress, bring about great change and cause multiple and multifaceted crises. An important public health problem whose complexity varies with many factors such as climate, traditions and in particular the health evolution already achieved.

Thus, Niger, a developing country, is industrializing more or less rapidly. In recent years, mechanization has revealed important new variables of interest to public health. As it develops, industry absorbs an increasing proportion of the world's workers. However, it is obvious and very necessary that the health problems of populations are affected by changes in the structure of the community and by new industrial methods and techniques which force them to make an effort to adapt and expose them to risks. Thanks to technical progress in industrial hygiene, both physical and chemical factors of aggression in working environments, which were very frequent in the first phase of the industrial revolution, have been largely controlled. Many occupational hazards and illnesses are a thing of the past in industrialized countries, although serious and collective episodes of preventable illness do occasionally occur in modern factories. In developing countries many new industries have instituted modern measures to protect the health of workers, but in most cases risks remain, in the rush to increase industrial production too many factories where, mainly due to lack of experience, considerations of occupational medicine have not received the required attention. This former agent in a cement production plant affirms that: *“Despite the technological and industrial evolution that we are witnessing every day, people are exposed to enormous health risks that are very often fatal. In almost all fields and services, people work without the least necessary protective measures”*.

3.2.6. Hygiene Climate Change and Public Health

Hygiene is an important element in the fight against disease contamination, especially in this context of climate change. In Niger, the Food exposure in polluted environment either by smoke released from vehicles or dust produced by climate change represents a big risk to public health.

In this context of climate change, health information remains impersonal averages at almost all levels. The available information, however, indicates a generalized trend affecting each in a specific and unique way. All people do not have the same reactions and they are not equal and identical in the face of disease and public health issues in general. For these reasons, it is therefore important to interpret health information according to the dangers it entails and their existence in order to adopt a qualified adapted lifestyle. Hygiene plays a very important role in the fight against the health impacts of climate change insofar as it protects against diseases caused by bacteria and viruses invisible to the naked eye. The lack of information on lifestyle can lead to and promote physical and psychological characteristics such as (weight, sensitivity to stress, fatigue, fragility or, on the contrary, particular resistance, etc.). It should be noted that family history, lifestyle habits and behaviors (diet, physical activity, consumption of tobacco, alcohol, etc.) are also personal factors that can influence the risks to which the man is exposed in this context. of climate change. In terms of prevention against diseases due to climate change, the right reflex is to play the rebalancing between these different factors that contribute to the deterioration of the physical and psychological environment of man.

Indeed, there are extremely important instructions in the health field that must necessarily be respected for a healthy and balanced lifestyle. However, certain conditions may prove difficult to follow, including from a financial point of view, especially in a country like Niger where the level of extreme poverty in 2020 at 42.9%, concerns more than 10 million people (World Bank, 2020). The food budget is indeed an important and mandatory expense to continue living. However, without trying to adopt an ultra-restrictive lifestyle due to a drastic and expensive health regime, some nutritional advice to stay in good and perfect health is quite easy to follow and not necessarily as expensive as you think.

3.2.7. Pesticide, Climate Change and Public Health

Pesticide some persistent pollutants that can both affect our health and our environment in contributing to release harmful gases in to the atmosphere, which can exacerbate climate change. The exposure to pesticides leads to respiratory diseases or to cancer.

Pesticides are dangerous and even deadly chemical elements when misused. Indeed, pesticides constitute a public health problem especially in developing countries where their use is done in a very risky and hasty way. Indeed, the use of any chemical product with harmful effects must be done according to the principles and the rules which govern its use. However, in developing countries, the majority of people who use these products do not know how to read even less than write to really know how to use a chemical product, when and by doing what? Yet pesticides are designed to kill or repel insects, weeds, rodents, fungi and other organisms that can threaten public health and national economies. However, when pesticides are misused or stored, these chemicals can also harm humans and be responsible for serious or even fatal accidents. There are many victims of pesticides in developing countries due to the lack of control over the conditions of its use and conservation. According to this agent of the Ministry of Agriculture: *"The impacts of climate change such as the drastic decrease in rainfall are at the root of the famines and repetitive food crises that the Sahelian populations and particularly those of Niger face. To adapt, farmers especially resort to pesticides in order to increase their production. However, many people use these products inappropriately, which is not without consequences for their health. The government must make every effort to train and educate people on how to use pesticides and support them in their supply"*.

According to the World Health Organization report, the annual number of pesticide poisonings is estimated between 1 and 5 million, including several thousand fatal cases; other studies have confirmed this heavy pesticide-related mortality by estimating the annual number of deaths at around 300,000 cases. It is estimated that 99% of these fatal poisonings are recorded in developing countries, which are particularly affected by this scourge due to a lack of regulation, surveillance systems and insufficient access to systems of prevention.

information. The number of children involved in these incidents is unknown as the majority of studies have focused on intentional poisonings in adults, but based on experience from many countries the incidence in children is likely to be significant. Sanae Achour et al. (2011).

3.2.8. Deforestation, Climate Change and Public Health

More trees down increases CO₂ amount into the atmosphere that lead to global warming and climate change. With less trees, we have less rainfall and that can lead to a situation of drought with water scarcity or food insecurity, affecting human health.

Niger was in the past a country of great forests, especially in its part fed by the Niger River. This immense natural resource is shared with various animal species that found their sustenance, a place of rest and refuge. The populations living in this environment took advantage of the benefits provided by nature, which significantly improved their living conditions. However, it is clear today that these once green spaces have become immense gray desert expanses. This difficult situation is caused by rapid urbanization, the expansion of agricultural and pastoral land and the exploitation of wood for economic purposes, the steep increase in the population and its need for firewood and the non-reforestation of destroyed spaces. in the whole country.

Indeed, the major causes and manifestations of land degradation are climate change. This climatic upheaval is mainly due to insufficient rains, but sometimes torrential, irregular and poorly distributed in space and time, as well as frequent and strong winds which erode the agro-pastoral lands. To cope with all these climatic hazards, producers are increasing the cultivated areas to the detriment of soil fertility management practices, such as fallowing. In addition, overgrazing in the same area, uncontrolled exploitation of forests to meet wood energy and service needs, poor harvesting practices for forest products used in traditional medicine and bush fires are all human activities that contribute to the regression of plant cover and thus promote land degradation and the advance of the desert. The concentration of $\frac{3}{4}$ of the country's population in only $\frac{1}{4}$ of the national territory is also another major concern in terms of the management of productive land in this Sahelian country.

Land degradation trends are characterized by deforestation and desertification which are progressing inexorably, reaching 75% of the national territory. Natural forest formations have shifted from a forest country to a treeless country, due to agricultural clearing, timber harvesting and climate change. In addition to overgrazing, the abusive cutting of aerial pasture and the loss of woody cover following drought and deforestation, lead to land degradation and accentuate the process of desertification.

The combination of all these climatic factors negatively affects human health and exposes people to the risk of very dangerous diseases. At this level, the environment plays a preponderant role in the protection and the fight against certain categories of diseases that populations face. Wanting to solve this public health problem means clearly defining the different mechanisms for adaptation, mitigation and the fight against the impacts of climate change as well as the corollary issues.



Source: Boureima, H. (2021)

IV. Conclusion and recommendations

This analyzes the consequences of climate change on human live conditions and public health in the Niger Republic. The findings showed that in the Niger Republic the population experienced serious threats due to the various manifestations of climate change that affect the quality of their life and health. The main adverse impacts of climate change that affect and human health in the agro-pastoral regions included the rainfall deficit, the desertification, floods, high temperatures, droughts. Further, anthropogenic actions accelerated this phenomenon by causing soil degradation and other associated consequences that led to drastic and consequences affecting human health.

Moreover, the country key economic sectors; agriculture and livestock largely dependon climatic conditions. Considering that around 85% of the rural population of the country is engaged in agriculture and livestock sectors the impacts of climate change could be potentially devastating for the development of the country. Likewise, the recurrence of extreme climatic events has negatively affected health due to the appearance of new diseases.

Consequently, the increase in climate change and the multiplication of its impacts constitute a permanent danger to the health of the population. These characteristics also serve as channels for the continued deterioration of living and working conditions in countries like ours. This is why it is necessary and very urgent to make proposals and recommendations to help these populations trapped by climate change and its direct or indirect impacts.

Some recommendable alternative to climate change effects on public health.

- Proper sewage disposal helps to keep our living environment clean, and alleviate our exposure to parasites that cause diseases;
- Avoid burning our waste because they are inducing carbon dioxide production and lead to climate change;
- To prevent climate-related diseases such as malaria, sleep under mosquito nets is compulsory;

- Trees are known to mitigate climate change through their role in the carbon cycle and to avoid heat wave (which can affect our skin, health). Planting trees to cool and refresh our living environment can be a climate friendly action that need to be promoted;
- The Niger government and its technical and financial partners must create the conditions so that the populations have drinking water everywhere in the country;
- Raise public awareness of the importance of hygiene in the prevention and fight against diseases;
- Integrated water resources management is an alternative way to face climate change hazards affecting water availability and health condition;
- Adding cow dung to the soil to improve productivity and it is climate friendly.

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