The Impact of Climate Change in Developing Countries: Increasing Rates of Under-5 Mortality

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THE IMPACT OF CLIMATE CHANGE IN DEVELOPING COUNTRIES:

INCREASING RATES OF UNDER-5 MORTALITY

ABSTRACT

This paper proposes that the lack of access to safe drinking water of the climate change in the Sub-Saharan Africa is going to redound in the increase of death of children less than five years old.
INTRODUCTION

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INTRODUCTION

The consequence of the increasing lack of access to fresh water as a result of global warming will be an increase in the mortality rate of children less than five years old in developing countries like Nigeria and the Democratic Republic of Congo (DRC). The most significant threat to health for these children comes from diarrhoeal diseases and these are the countries which already have the highest rates of deaths from diarrhoeal diseases in Sub-Saharan Africa. It is vitally important to take notice of this impending health disaster both because it is preventable and because it could be replicated in other countries.

One of the principle effects of climate change is an increase in "water stress", a term describing the situation when the demand for water exceeds its availability.\(^1\) It has been predicted that by 2020, between 75 and 250 million people in Africa will be exposed to increased water stress due to global warming.\(^2\)

According to the World Health Organization (WHO), diarrhoeal diseases rank third among the top ten causes of death around the world.\(^3\) In addition, they rank second among the causes of deaths among children under five years old.\(^4\) Children in developing countries are most often the victims.\(^5\) Diarrhoeal diseases in developing countries are very often the result of contaminated food and water sources.\(^6\) Thus a key step that must be taken to prevent these deaths is improving access to safe drinking water.\(^7\)

Nigeria and the Democratic Republic of Congo are the countries with the highest under-5 mortality rates in the Sub-Saharan Africa, which had the highest number of under-5 deaths per 1,000 live births in 2008 of any region in the world, according to the Statistics Division of the Department of Social Affairs of United Nations.\(^8\) Insufficient infrastructure and the consequent
lack of safe water are the major reasons why Sub-Saharan Africa is so vulnerable to water stress. In at least eight sub-Saharan countries only twenty to thirty-four per cent of the population has access to safe water.

This paper is divided into two parts. The first section gives an account of the current situation in Sub-Saharan Africa (and specifically in Nigeria and the DRC) in terms of diarrhoeal diseases, under-5 mortality rates and the availability of water supplies and sanitation coverage. In addition, the author will discuss the connection between climate change and water stress and forecasts of how climate change will impact Sub-Saharan Africa in the future.

The second section of the paper analyses the challenges faced by water supply, sanitation and health systems in Nigeria and the DRC. In conclusion, the author will suggest possible ways to improve these health systems in order to be better prepared for the effects of climate change in coming years.

BACKGROUND

Under-5 deaths in Sub-Saharan Africa
With a rate of 144 per 1,000 live births by 2008, Sub-Saharan Africa is the region with the highest rate of under-5 deaths in the world. The same report identifies diarrhoeal diseases and pneumonia as the main killers of these children. It worth mentioning that also in 2008, the WHO ranked diarrhoeal diseases third place on a list of the worldwide leading causes of death.

The WHO gives the following definition of diarrhoea:

Diarrhoea is defined as having loose or watery stools at least three times per day, or more frequently than normal for an individual. Though most episodes of childhood diarrhoea are mild, acute cases can lead to significant fluid loss and dehydration, which may result in death or other severe consequences if fluids are not replaced at the first sign of diarrhoea.

The WHO gives the following explanation of the causes of diarrhoea:

**Infection:** Diarrhoea is a symptom of infections caused by a host of bacterial, viral and parasitic organisms, most of which are spread by feces-contaminated water. Infection is more common when there is a shortage of clean water for drinking, cooking and cleaning. Rotavirus and Escherichia coli are the two most common causes of diarrhoea in developing countries.

**Malnutrition:** Children who die from diarrhoea often suffer from underlying malnutrition, which makes them more vulnerable to diarrhoea. Each diarrhoeal episode, in turn, makes their malnutrition even worse. Diarrhoea is a leading cause of malnutrition in children under five years old.

**Source:** Water contaminated with human feces, for example, from sewage, septic tanks and latrines, is of particular concern. Animal feces also contain microorganisms that can cause diarrhoea.

**Other causes:** Diarrhoeal disease can also spread from person-to-person, aggravated by poor personal hygiene. Food is another major cause of diarrhoea when it is prepared or stored in unhygienic conditions. Water can contaminate food during irrigation. Fish and seafood from polluted water may also contribute to the disease.

In addition, the WHO recommends the following "key measures" for the prevention and treatment of diarrhoea:

- access to safe drinking-water
- improved sanitation
exclusive breastfeeding for the first six months of life
- good personal and food hygiene
- health education about how infections spread
- rotavirus vaccination.\textsuperscript{15}

At least eighty per cent of child deaths from diarrhoea occur in Africa and South Asia. Annually, three quarters of the under-5 deaths caused by diarrhoea occur in fifteen countries located in those regions.\textsuperscript{16}

Among those fifteen countries, Nigeria and the DRC rank second and third with 151,700 and 89,900 annual child deaths due to diarrhoea, respectively.\textsuperscript{17}

Water supply and sanitation in Nigeria and the Democratic Republic of Congo

Nigeria

According to the Presidential Water Initiative Workshop proceeding of August 2003, “Nigerian water supply coverage is fifty-seven per cent. There is sixty-seven per cent coverage in the state capitals, sixty per cent coverage in urban areas, fifty per cent coverage in semi urban areas, and fifty-five per cent coverage in rural areas.”\textsuperscript{18} In addition, the same document reports the following about the sanitary system:

According to the 2004 NDHS, 15\% of households use flush toilet, 57\% use traditional pit latrines and 28\% have no facility. Urban households are more than four times as likely to have a modern flush toilet as households in rural areas (29\% and 7\% respectively). However, KAP studies in 1999 indicate that most traditional pit latrines in use were unsafe.\textsuperscript{19}

In summary, just over half of the Nigerian population has access to the public water supply, and forty-three per cent of the Nigerian households lack sanitation facilities. The lack of infrastructure for water supply and sanitation exacerbates water contamination.
Democratic Republic of Congo

According to the Joint IDA-IMF Staff Advisory Note on the Poverty Reduction Strategy Paper:

The available statistics show that approximately 22.0 percent of the population (12.0 percent in rural areas and 37.0 percent in urban areas) have access to drinking water. This availability is spread unevenly throughout the country. For example, in the Banalia Health Zone (Orientale Province), only 3.0 percent of the inhabitants have access to drinking water. In Kindu (Maniema Province), 91.0 percent of the water supply sources for the people are not protected. A survey covering 36 health areas has shown that in Ituri (Orientale Province), 65.0 percent of the springs and wells used by the people are not protected.20

The same document says the following about water sanitation in DRC:

As regards sanitation, at the level of the people the situation is basically one of households' inabilitys to access an adequate system for the evacuation of solid and liquid waste. The surveys conducted in preparing for the general status of health (1999) revealed that some 17.0 percent of households have hygienic latrines and 25.0 percent properly evacuate household waste. In addition, the MICS 2 survey indicates that the rate of hygienic evacuation of waste water was 9.1 percent in 2001. The various surveys conducted and the results of epidemiological analyses indicate that over 80.0 percent of the instances of disease are attributable to poor environmental conditions. Garbage is tossed into the streets, natural needs are met in nature, youth are not made aware of the benefits of cleanliness, there are no landfills, drainage works are not in use, waste water runs along the road, there is no structured system of any kind for the removal of special waste (biomedical waste, plastics, scrap), and there is no control of atmospheric pollution.21

In summary, the DRC’s water supply coverage is twenty-two per cent, most of it in urban areas. Eighty-three per cent of households in DRC lack proper sanitation facilities.

Health systems in Nigeria and DRC

Nigeria

In 2009 the WHO Country Cooperation Strategy at a glance document described the following challenges faced by the Nigerian health system.

- Low population coverage with unequal access to adequate health services, clean water and sanitation;
- Strengthening the LGAs and the Ward Health Systems to deliver comprehensive primary health care;
- Inadequate health information systems for monitoring and analysis of health indicators;
- Human Resource capacity development throughout the health sector. Need for intensive recruitment of national staff to fill of the established posts at the periphery;
- Channeling the available substantive internal resources to deliver essential services and available technologies.

In the author's opinion, one of the main problems of the Nigerian health system is the way it is funded. Nearly sixty-five per cent of its income comes from out-of-pocket payments, a product of the very scarce insurance coverage among the population. In a country where over ninety per cent of the population survives on less than two dollars a day, expecting to fund health care through patient payment is totally unrealistic, and, in fact, discourages citizens from accessing badly needed care.
Democratic Republic of Congo


In 2009 the WHO Country Cooperation Strategy at a glance document described the following challenges faced by the health system in the Democratic Republic of Congo.

- Rebuilding health systems capable of meeting the needs of people coming out of several years of crisis (armed conflicts, natural disasters)
- Establishing a funding system care for equity of access
- Improving the management capacity of the entire health system in accordance with the new Constitution which establishes decentralization with specific skills at every level of the country
- Developing and/or strengthening and popularizing policies and strategies in certain strategic areas
- Reducing excess morbidity and mortality including the implementation of multisectoral programs that perform the fight against disease by taking into account determinants
- Dealing effectively with emergencies including management of humanitarian action and sexual violence
- Strengthening the leadership of the Ministry of Health in a context of multiple partnerships

The DRC is a young country with a history of colonization and repeated violent struggles including civil war as recently as 2001. Facilities that previously existed have been mostly
In the author's opinion, the rebuilding of the DRC’s health system is the first and most important step in order to improve health conditions.

Conclusion

Although the economies of Nigeria and the DRC are different (the Nigerian economy is stronger), the countries share similar problems of poor water supply and sanitation coverage, which are reflected in high rates of illnesses due to water contamination (mainly diarrhoeal diseases) which are the principle cause of death of children under five years old. In addition, in both countries, the majority of the population is without health insurance. In order to reduce under-5 deaths due to diarrhoea, there must be an improvement in access to safe water as well as major advances in the construction and organization of health and sanitation systems.

Climate Change

Climate change and global warming are defined by the U.S. Environmental Protection Agency (EPA) as follows:

Climate change refers to any distinct change in measures of climate lasting for a long period of time. In other words, “climate change” means major changes in temperature, rainfall, snow, or wind patterns lasting for decades or longer. Climate change may result from:

• natural factors, such as changes in the Sun’s energy or slow changes in the Earth’s orbit around the Sun;
• natural processes within the climate system (e.g., changes in ocean circulation);
• human activities that change the atmosphere’s make-up (e.g., burning fossil fuels) and the land surface (e.g., cutting down forests, planting trees, building developments in cities and suburbs, etc.).

Global warming is an average increase in temperatures near the Earth’s surface and in the lowest layer of the atmosphere. Increases in temperatures in our Earth’s atmosphere can contribute to changes in global climate patterns. Global warming can be considered part of climate change along with changes in precipitation, sea level, etc.\(^ {30} \)

In summary, the term "climate change" describes changes in the climate on a long-term basis, while "global warming" is the increase of the planet’s average temperature.

Fresh water resources are one key area of the environment where scientists have predicted that the impact of climate change will have notable effects. The Intergovernmental Panel on Climate Change (IPCC) describes those consequences in its 4th Assessment Report as follows:

By mid-century, annual average river runoff and water availability are projected to increase by 10-40% at high latitudes and in some wet tropical areas, and decrease by 10-30% over some dry regions at mid-latitudes and in the dry tropics, some of which are presently water-stressed areas. In some places and in particular seasons, changes differ from these annual figures.

Drought-affected areas will likely increase in extent. Heavy precipitation events, which are very likely to increase in frequency, will augment flood risk.\(^ {31} \)

Elsewhere in the same report, the IPCC specifically points to Sub-Saharan Africa as a region that is highly vulnerable to climate change "because of [its] current low adaptive capacity." In other words, the region, because of its underdevelopment, is not well prepared to react to changes caused by climate change by taking rapid measures on a mass scale such as building new infrastructure or carrying out public information campaigns that would be much more easily accomplished in wealthy industrialized countries.\(^ {32} \)
According to the United Nations Environment Programme (UNEP), “water stress causes deterioration of fresh water resources in terms of quantity (aquifer over-exploitation, dry rivers, etc.) and quality (eutrophication, organic matter pollution, saline intrusion, etc.).”\(^{33}\)

"Water stress" on the scale of an entire country is contrasted with "water scarcity" as follows:

A country is said to experience "water stress" when annual water supplies drop below 1,700 cubic meters per person. At levels between 1,700 and 1,000 cubic meters per person, periodic or limited water shortages can be expected. When annual water supplies drop below 1,000 cubic meters per person, the country faces water scarcity.\(^{34}\)

Water scarcity has been described as having two different facets:

**Economic scarcity**

Economic scarcity is caused by a lack of investment in water or a lack of human capacity to satisfy the demand for water. Much of the scarcity is due to how institutions function, favoring one group over another and not hearing the voices of various groups, especially women. Symptoms of economic water scarcity include scant infrastructure development, either small or large scale, so that people have trouble getting enough water for agriculture or drinking. And even where infrastructure exists, the distribution of water may be inequitable. Much of Sub-Saharan Africa is characterized by economic scarcity, so further water development could do much to reduce poverty.

**Physical scarcity**

Physical scarcity occurs when there is not enough water to meet all demands, including environmental flows. Arid regions are most often associated with physical water scarcity, but water scarcity also appears where water is apparently abundant, when water resources are overcommitted to various users due to overdevelopment of hydraulic infrastructure, most often for irrigation. In such cases there simply is not enough water to meet both human demands and environmental flow needs. Symptoms of physical water scarcity are severe environmental degradation, declining groundwater, and water allocations that favor some groups over others.\(^{35}\)

By 2007, the region with the most water scarcity was Sub-Saharan Africa.\(^{36}\)
In summary, the impact of climate change on global freshwater resources causes the populations of some regions to suffer water stress, meaning not having sufficient water to supply their basic needs such as drinking, cleaning, food preparation and irrigation for agriculture. When the water supply drops below 1,000 cubic meters per person, the population faces what is called water scarcity. Water scarcity stems from environmental causes, but is usually also the result of human activity. A population is said to face economic water scarcity when it is unable to create the necessary infrastructure to access safe water although bodies of water with sufficient capacity to supply their needs may exist. On a worldwide scale, Sub-Saharan Africa is the region that is the most affected by water scarcity. In addition, it is among the regions forecasted to be the most heavily impacted by climate change.

**Impact of climate change in the Sub-Saharan Africa**

According to projections by the IPCC in its Fourth Assessment Report, between seventy-five and 250 million people in Africa will be exposed to increased water stress due to climate change by 2020. For the purposes of the present paper, the author will focus on the possible impact of climate change in Nigeria and DRC.

**Nigeria**

According to the IPCC, “the coastal nations of west and central Africa,” including Nigeria, that “have low-lying lagoonal coasts . . . are susceptible to erosion and hence are threatened by sea-level rise.” Furthermore, “Africa's west coast often is buffeted by storm surges and currently is at risk from erosion, inundation, and extreme storm events. Inundation could be a significant concern.”

**Democratic Republic of Congo**
The following possible effects of climate change have been noted in the DRC. “Lake levels in Lake Tumba in the Democratic Republic of Congo (Inogwabini et al., 2006) and Lake Victoria (Birkett et al., 1999; Latif et al., 1999) have been attributed to climate variations and may become more variable in the future.” Also, “after the 1997 flood, Lake Tanganyika rose by about 2.1m, and very high river-flows were recorded in the Congo River at Kinshasha. The heavy rains and floods have been attributed to large-scale atmosphere ocean interactions in the Indian Ocean.”

Impact of rising sea levels, floods and drought

Rising sea levels, floods and droughts create obstacles to a population's ability to access safe drinking water. The rising of sea levels described above as a consequence of climate change does not include the possibility of a tsunami, (whose effects on water resources can be imagined). However, the rising of sea levels means the incursion of seawater into the rivers that flow into the sea. Sea water is not fit for human consumption because “human kidneys can only make urine that is less salty than salt water. Therefore, to get rid of all the excess salt taken in by drinking seawater, you have to urinate more water than you drank. Eventually, you die of dehydration even as you become thirstier.” Salinization of any body of water makes that water unfit for human consumption.

Floods can also contaminate drinking water. The Washington State Department of Health gives the following description of how this occurs:

**Surface water sources:** Increased water flow during a flood often makes rivers and streams murky. Elevated turbidity in source water could make it impossible for a water system’s treatment plant to treat water. If that occurs, the water system may have to rely on emergency storage capacity or an emergency water source.
Either way, the water system will have to ask customers to conserve water. That request can confuse customers when flooding or heavy rains make it look like there’s water everywhere. Even if the water system can overcome high turbidity, the change in disinfection levels may cause taste or odor problems in the treated water.

**Groundwater sources:** Contaminants can enter the water supply if the wellhead or the areas immediately around the wellhead flood.

**Distribution systems:** Contaminants can enter the water distribution system if a significant loss of pressure occurs when all or part of the service area floods.41

Finally, droughts can also have a negative effect on a population's access to safe drinking water. One of the first signs of drought is a decrease in the water level of rivers and lakes.44 According to the U.S. Geological Survey, “when rainfall is less than normal for several weeks, months, or years, the flow of streams and rivers declines, water levels in lakes and reservoirs fall, and the depth to water in wells increases.”45

A decrease in the water level of rivers and lakes and an increase in the depth of water in wells might decrease the quantity of water available to a population. Reduced water quantity can also negatively affect water quality because “a decline in material transport from the watershed during drought is countered by an increase in retention of some materials as water residence time increases and evaporation increases relative to precipitation.”46

In summary, rising sea levels, floods and droughts will reduce the amount of safe drinking water available to a population. While Nigeria and the DRC have substantial geographical differences, they will both be affected by climate change. In the case of Nigeria, the threat comes from rising sea levels, while the DRC is threatened by floods. Both circumstances would negatively impact the population's ability to access to clean drinking water and maintain necessary sanitation levels, likely leading to further spread of diarrhoeal diseases.
The already very serious problem of water scarcity in Sub-Saharan Africa and the region's lack of infrastructure leave the population unprepared and highly vulnerable to the negative health impact of the probable increased water stress in the years ahead as a result of climate change.

**ANALYSIS**

Lack of access to safe drinking water triggers diarrhoeal diseases
According to the WHO, diarrhoea is a symptom of infection caused by a host of bacterial, viral and parasitic organisms most of which can be spread by contaminated water. It is more common when there is a shortage of clean water for drinking, cooking and cleaning and basic hygiene is important in prevention. For example, in August, 2006, after the April rain fall in Kenya and Ethiopia, UNICEF reported that, according to local health officials there was a reduction in available safe drinking water and a resultant rise in diarrhoea among under-five children.

The health systems of Nigeria and DRC are not prepared

**Nigeria**

The health system in Nigeria has been described in the first part of this paper. The Nigerian health system is not well prepared to confront a potential increase of diarrhoeal diseases, and a consequent rise in under-5 deaths, mainly because of its low population coverage and the weakness of the primary health care system.

**Democratic Republic of Congo**

The health system in the DRC has been described in the first part of this paper. The health system in the DRC is not well prepared to confront a potential increase of diarrhoeal diseases, and a consequent rise in under-5 deaths, mainly because of the lack of a basic health care infrastructure or the necessary funds or regulatory framework to develop such an infrastructure. With no real health system in place, preventing an increase of under-5 deaths from diarrhoeal diseases will not be possible.
Suggestions

The main objective of this paper is to show the link between the rising of global temperatures and the likelihood of an increased rate of under-5 mortality in Sub-Saharan Africa. A discussion of the possible measures that might be implemented to improve the water supply and sanitation systems of Nigeria and the DRC is beyond the scope of this paper. Instead, the author will discuss measures that might be taken to improve these countries' health systems.

The WHO has recommended the following key steps to reduce child deaths from diarrhoea:

- Mobilize and allocate resources for diarrhoea control.
- Reinstate diarrhoea prevention and treatment as a cornerstone of community-based primary health care.
- Ensure that low-osmolarity oral rehydration sales (ORS) and zinc are adopted as policy in all countries.
- Reach every child with effective interventions.
- Accelerate the provision of basic water and sanitation services.
- Use innovative strategies to increase the adoption of proven measures against diarrhoea.
- Change behaviors through community involvement, education and health-promotion activities.
- Make health systems work to control diarrhoea.
- Monitor progress at all levels, and make the results count.
- Make the prevention and treatment of diarrhoea everybody’s business.
- Families and communities can ensure that breastfeeding, handwashing, sanitation and the treatment of household water receive the priority they deserve.
- The public sector can advance comprehensive prevention and treatment programmes at both the national and local levels, not only through the ministry of health but also through agencies involved in education, commerce, water and sanitation, nutrition, women’s affairs and urban and rural development.
- The private sector can promote innovation in the supply and delivery of key interventions, in partnership with public institutions.
- Government leaders can expand public awareness of the problem and its solutions, thereby increasing demand for services to reduce deaths from diarrhoea.
- Global partnerships and networks can forge new links across initiatives, leading to strong and effective advocacy and reducing the risk of competing activities. 49
All of these strategies can and should be applied in Nigeria and the DRC. However, it would be useful to highlight certain points in relation to each country.

Regarding the Nigerian health system, it is especially important to follow the recommendation related to accelerating the provision of basic water and sanitation services. As noted previously, water supply coverage currently only reaches fifty-seven per cent of the Nigerian population and and forty-three per cent of the Nigerian households lack sanitation facilities. In both cases, the problem is more pronounced in rural areas. Thus, efforts to augment water and sanitation services in the rural areas of Nigeria will be a vital step towards reducing disease and deaths from contaminated water.

The DRC's health system currently only exists in an embryonic form because of the lack of a legal structure and funding in the wake of recent civil war. Therefore, strengthening water and sanitation services and working to change the population's behavior in relation to water consumption and other use through community involvement, education and health-promotion activities are vitally necessary measures in the interim period before a new health system can be constructed.

CONCLUSION
Global warming and other aspects of climate change will increase water stress and most likely lead to more under-5 deaths in Sub-Saharan African countries like Nigeria and the Democratic Republic in the coming decades. In both of these countries water and sanitation services are ineffective and the health systems have low coverage and a severe lack of funding. Furthermore, in both countries the majority of the population is not able to pay for health insurance. Because of these problems, one can only conclude that Nigeria and the DRC are unprepared to cope with the rise of diarrhoeal diseases that will result from increased water stress.

In order to prevent the unnecessary death of thousands of children in Sub-Saharan Africa, major initiatives must be launched to strengthen health system infrastructure, improve water supply and sanitation systems, vaccinate children against rotavirus infections and educate the population on safe habits of hygiene. There must be a recognition that these and other necessary measures simply cannot be accomplished without substantial funding which governments in Sub-Saharan Africa are unable to provide. The international community must recognize that it has a responsibility to act and play a decisive role in preventing a human tragedy, by providing both logistical and planning support as well as generous financial aid.

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