The Impact of Flood and Drought on Sanitation and Public Health of Vulnerable Communities in Nigeria.

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Abstract

The Sustainable Development Goals (SDGs) were set to meet most challenges facing mankind by 2030. Among these SDGs are good health and wellbeing in goal 3 as well as clean water and sanitation captured as goal 6. Nigeria is faced with numerous challenges and is feared to pull the globe backwards in terms of meeting these goals by 2030. In view of the need for a concerted action towards ensuring the delivery of these goals, this research was conducted to highlight the setbacks to delivering good sanitation and public health by 2030. Specifically, Flooding and Drought were considered in Nigeria vulnerable communities. This study showed that these disasters contribute to numerous public health and sanitation challenges in Nigeria. Vulnerable communities were shown to depend on nearness to the major rivers but not restricted to these areas. The causes of these disasters showed to be both natural and anthropogenic. While we must only plan to manage the natural factors, the anthropogenic factors could be reduced to be barest. In Nigeria, these anthropogenic causes of flood and drought disaster centred more on population growth, urbanisation as well as industrialization. These are made worse by the failure of government at all levels to monitor adequate environmental planning to cushion the effects of these necessary activities. Further, the failure of relevant agencies to offer a proactive approach to disaster response has continued to affect the development of these goals. The need for a concerted approach towards the delivery of these key goals cannot be over stressed. It is important that research is encouraged and recommendations of research implemented towards managing these unavoidable disasters. Research will highlight better ways of handling these menace while the proper execution of the research by all stakeholders will put the findings of research in place to ensure reduced effect of thee disasters. If this is done, the delivery of these goals will become more hopeful within the expected time.

Keywords: Sustainable Development Goals (SDGs), disaster, flooding, drought, sanitation, public health.

Introduction

The ecosystem is naturally structured to be self-sustaining and sufficient. However, numerous anthropogenic activities have placed the ecosystem on the receiving end. This has led to an imbalance in the system with consequences. Some of these consequences have left the global community truly worried. Climate change is one of these phenomenal results of man's activities on the ecosystem[1-3]. Climate change is mainly due to the introduction of carbon dioxide and other greenhouse gases into the atmosphere leading to global warming[1-4].

Climate change is a change in the state of the climate, identifiable by changes in the mean and/or variability of climatic properties over a long period of time[4]. Climate change is a term only used if the

changes do not reverse[4]. It is usually caused by natural (biogeographical) or human (anthropogenic) activities. Climate change has become more emphatic recently due to an increase in human activities leading to increase in the release of carbon dioxide and other greenhouse gases[2-4]. The United States Environmental Protection Agency[1] has reported up to 40 percent increase in emission between 1700 and 2016. Reactions of these greenhouse gases in the ecosystem has led to numerous adverse effects[4].

Overcoming the problems of Climate change has become a global issue. The effects of climate change is felt globally and more in developing countries, like Nigeria[4,5].This calls for lots of proactive steps, all concerted to ensure results[4].

These reactions of greenhouse gases either lead to decrease or increase in temperature (Figure 1). On the basis of this changes in temperature, flooding and drought are key among these results [2-6].

Figure 1: Effects of Climate Change (Sourced from ESI-Africa)

Flood is the case when a large volume of water arrives at a stream channel and its flood plain within a time too short to forestall its consequences[8]. Flood plains are created by the overflow of this high volume of water onto surrounding land. There has been increasing concerns globally on the issue of flooding[6]. Floods account for up to one third of all deaths from disasters[8-9].Further, it has also led to economic losses amounting to billions of dollars [6]. In Nigeria, flooding accounts for the greatest loss from natural disasters[13].

Flooding in Nigeria has gained increasing relevance over the years based on frequency and resulting effects[6-9]. This has been blamed on urbanization, industrialization, rapid population growth and failure of government and other stakeholders[6-8]. Flooding in Nigeria may be fluvial or river, coastal or pluvial or urban based on their sources and location of occurrence[6, 8, 13]. Flood has many grave consequences bothering on environmental sanitation and public health. Some of these consequences include mortality, physical injuries, widespread infection, vector-borne diseases, economic disruptions and reduction in overall sanitation[2-6, 8, 13].

Drought is another effect of climate change. This hazard has gained more relevance considering the decline in water resources matched by increasing demand[10]. It is characterised by a myriad of climatological and hydrological factors. An understanding of these factors is necessary for mitigating the effects of drought[10-11]. Usually, drought may occur anywhere, but is primarily caused by a reduction in the amount of rainfall over a long period of time[10]. This change in rainfall regime is linked to an increase in temperature based on climate change/global warming [1-3, 10]. Studies have shown that the effects of drought include reduced water quality and supply, reduced crop yield, diminished hydropower generation and other economic and social effects[10].

Different countries demonstrate different levels of vulnerability to natural disaster. This generally depends on the geographical location with reference to the equator, as well as measures taken towards the mitigation of these disasters[7]. African countries, like Nigeria, have shown higher vulnerability to these hazards because of their location as well as lack of proper planning to forestall the effects of forecasted disasters[7]. The location of certain Nigerian cities to high risk areas and the exponential population growth coupled with improper planning are key to the effects of these hazards in recent years.

Aware of numerous global challenges, the United Nations launched the Sustainable Development Goals (SDGs) in 2015. These goals were set with a target to solve most global challenges by 2030. Among the goals are Public Health and Sanitation. Nigeria has been struggling to meet these goals on schedule[28]. This paper therefore aims at reviewing the effects of drought and flooding on the sanitation and public health of vulnerable communities in Nigeria. This is considering the gap existing with consequent calls for a holistic approach to understand these challenges and proffer solutions. The following sections of this chapter, shall expose the effects of flooding and drought on the system while pointing out ways of improvement.

Vulnerable Communities in Nigeria

Although flooding and drought are not new, the incidence of these two have increased in Nigeria in recent years. This has placed some communities on the vulnerability list of these disasters. Vulnerability evaluates the extent to which a potential hazard can affect individuals or a community upon exposure [14]. These effects may be physical, economic, social or environmental[13]. Predicting vulnerable communities is achieved with mapping and simulations using available data[13].Considering the nature of these disasters as emanating from global warming and climate change, vulnerable communities in Nigeria depend on location. The location of these communities shall be considered in consideration of the two major rivers in Nigeria; rivers Niger and Benue (Figure 2). Communities are grouped as vulnerable, based on their proximity to hazard source[7-8]. For a community to be declared vulnerable,

three components are considered; exposure, sensitivity and adaptive capacity[14]. For clarity, we shall consider these vulnerable communities for flooding and drought separately.

Communities Vulnerable to Flood

Flooding is usually the result of increased precipitation, leading to overflow of water banks. On this basis, most vulnerable communities fall around the banks of the two major rivers in Nigeria (Fig.2).

Figure 2; Map of Nigeria showing Rivers Niger and Benue (Source: researchgate.net)

The July 2012 flood in Nigeria was the worst in 40 years[13]. The flood recorded damages in 33 states[13], with Kogi, Niger, Benue, Nasarawa and Kwara leading (fig. 3). In 2018, flood affected up to 1.4 million Nigerians across 34 states with emergency declared in Anambra, Delta, Kogi and Niger[16]. This flood was traced to excess rainfall leading to overflow of both rivers Niger and Benue. Landscapes identified as prone to flooding are low lying coasts, deltas and small basins[8, 13].

The importance of identifying vulnerable communities cannot be over mentioned. This is considering the difficulty in recovering from the great losses recorded especially in unpredicted floods[8].It is on this basis that plans could be made for mitigation in the event of a flood. Over the years, various vulnerable communities have been identified at various times. Various models have been employed in studies to highlight vulnerable communities. It is noteworthy that hazard and exposure are necessary occurrences for vulnerability to result[13]. The models have identified communities close to river banks as vulnerable. Makurdi and Lagos have been severally highlighted[13]. The communities listed have shown to share certain features both natural (location with respect to water bodies) and anthropogenic (planning and development) [13].

Communities Vulnerable to Drought in Nigeria

In contrast to the cause of flooding already stated, drought results due to a significant reduction in precipitation. This leads to a reduction in water resources from both surface and underground waterbodies[10]. Again, drought vulnerability depends largely on the location of any community with respect to the two major rivers (Fig. 2).

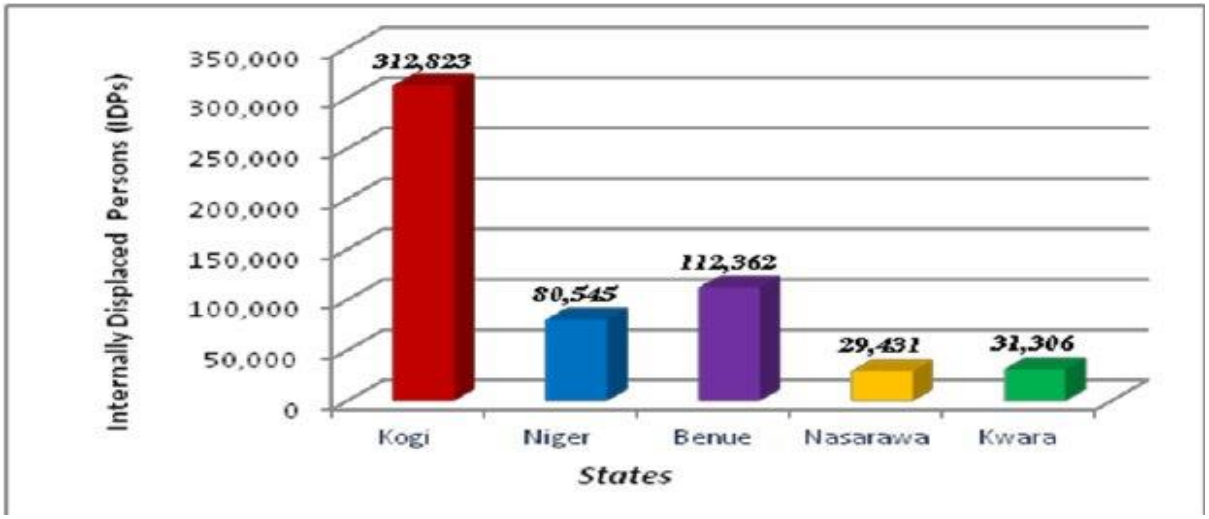

Figure 3: Highlight from 2012 Flood (Source: researchgate.net)

Generally, the Sudano-Sahelian Zone (SSZ) (Fig. 4) has been identified as most vulnerable to drought since the 18th century till date[14]. The drought vulnerability of a community depends on ecological and land use factors as well as adaptive strategies deployed[14].

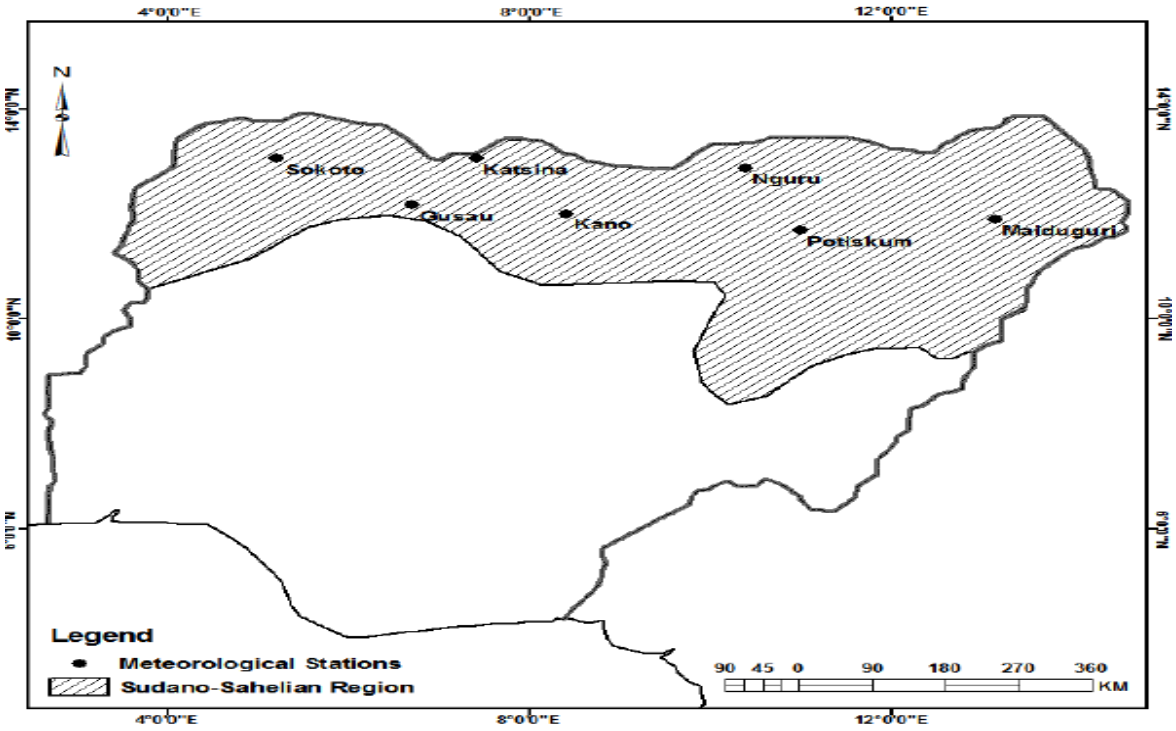

Figure 4: Map of Nigeria, showing the Drought vulnerable communities in the SSZ (Source: researchgate.net).

The level of vulnerability of these communities to drought depends on certain factors. These factors include duration, intensity or magnitude of the drought, ecological position of the community and efforts made towards adapting to the drought[14].

Impacts of Flood Hazards in Nigeria

The impacts of flooding in Nigeria are enormous. Over the years, various parts of the country have been hit by flood disasters with severe impacts. This recurring disaster has been blamed on climate change, rapid population growth and poor governance[20]. Poor governance has led to poor drainage and decaying infrastructure, lack of proper town planning and management strategies, poor waste management as well as inadequate preparedness even following flood warnings. Generally, low-lying areas are more exposed to the impacts of flooding, these are mostly coastal cities in Nigeria[8, 19-20]. Flood disasters have become more frequent in Nigeria causing devastating effects on vulnerable communities as well as the poor in urban cities[8, 20].

The impacts of flooding could be individual, household and community levels[19] and may lead to hunger, famine, disease and epidemic outbreak[8].Flood impacts seem similar across the levels identified. This chapter shall consider the impacts of flood in Nigeria across these levels.

Impacts of Flooding on Individuals

At the very lowest level of the communities are individuals. Some impacts of flood on individuals include economic or health implications[19]. Normally, individuals are at the receiving end of the effects of flooding. Thus, loss of jobs and loss of properties and investments are eventually traced to individuals. Their exposure to the polluted flood water also affects their health, thus loss of funds in hospital expenses. There is also the effect on the mental health of the individuals. These have manifested in phobia and compulsions. Studies report anxieties on the part of individuals following flood events [19]. This will lead residents of communities living in perpetual fear of another flood with consequences. This could lead to loss of appetite, loss of peace of mind, inability to sleep and sometimes depression[19].

Flood Hazards and Recent Trends in its Frequency

Flood hazard is used to define flood as a natural disaster only if there is threat to human life and property[8]. This is used to summarise all the risks or dangers associated with flood disasters. Prof S Nelson in his article, divided the hazards of flooding into three categories; Primary, Secondary and Tertiary hazards[17]. Primary flood hazards are those that crystalize based on contact with water. These hazards are usually due to the increased velocity with increased discharge of the flood water[17]. This increase in velocity of water may lead to

- Loss of Properties; based on the velocity of the flood water, many materials such as cars, bridges, houses among others may be carried away in the high flood current.
- Erosion will increase under the high velocity of flood. This increased rate of erosion could lead to collapse of structures such as houses. A good instance is seen along University of Nigeria Nsukka Road in Enugu state, Nigeria. There have been abandoned houses due to the heavy flood in that area. It is so bad that vehicles are unable to use that road during heavy down pours as many loss to lives and properties have been reported in recent years. The 2012 flood also covered multiple kilometres of urban road in affected cities [8].
- Damage to property as the surge is high, getting into homes and offices with resultant destruction of furniture and other valuables. The popular 2012 flood in Nigeria submerged houses and displaced up to 1.3 Million people nationwide[8], a number that increased to 1.4 million in 2018[16].
- Sanitation and Public Health Effects: As the flood flows with high velocity, it moves with a lot of debris on to undesired locations[17]. The velocity allows the water to move these materials, some wastes dumped at other sites. However, as soon as the water flow reduces, the velocity also reduces and so, these materials remain at unusual places thereby posing sanitation and public health challenges.

- Agricultural Effects: This may result in crop loss due to flooding of farmlands or livestock loss as these may be washed away with the flood. The 2012 flood in Nigeria covered several hectares of land while drowning many livestock.
- Humans are also drowned as a primary effect of flood. Reports have reported loss of humans to flood recently. In 2018, the International Red Cross Society reported 141 deaths and more than 200 wounded in the flood that affected 34 states in Nigeria[16]. In the 2012 flood, up to 431 people lost their lives[8].

Secondary effects of flood are those hazards that crystalize because of the primary effects[17]. This entail disruption of services in the metropolis such as;

- Pollution of Public Water Supply. This occurs if sewerage treatment plant and other contaminant sources are affected by the flood. This could lead to an outbreak of numerous diseases such as typhoid fever and cholera especially in in developing countries like Nigeria.
- Transportation systems may be disrupted based on the flow of water onto the road and destruction of infrastructures like bridges. There may be shortage of food and other supplies. Starvation could result especially in countries like Nigeria[17].
- Disruption of other services like gas and electricity.

Tertiary hazards that could result from flood include those effects that result from secondary effects of a flood as above. Generally, they are long term effects of flood[17], involving changes that may not be reversible. These changes include[17]

- The location of river channels may change due to a flood. Usually, new channels are formed with the old left dry.
- There could be a change in the topography of farmland for better or worse.
- The disruption of services could force some people out of their jobs
- Wildlife habitats may be upset by flood.

Flood disaster has shown an increasing trend recently with several reports of its effects. The last century has seen flood being the lead to most loss in terms of humans and properties[17]. Within the last decade, Nigeria has experienced the greatest effects of flood. Most remarkable was the 2012 flood that is ranked the worst in 40 years[13]. The flood left about 1.3 million Nigerians displaced with numerous deaths and others injured. The flood events of 2018 was another catastrophe of the decade. This disaster affected up to 80 percent of Nigeria[18]. About 1.4 million Nigerians were displaced as a result of this flood[16]. A review between 1985 and 2014 showed that up to 11 million lives have been affected, with a death toll of up to 1100 and loss of property beyond 17 billion USD[6].

Overall, there has been a marked increase in flood disasters in Nigeria. This is predicted to increase further in future[8]. There seems to be greater effect of flooding on the basis of urbanisation and population growth than due to location in proximity to the river banks[6].

Impacts of Flooding on Households

Notable impacts on households exposed to flood in Nigeria has been reported[19]. These impacts bother on the social and economic well-being of members of families. There has been cases of flood water reaching the waist level of family members in their houses. This leads to diseases and visits to hospitals on health grounds [19]. Further, scarcity of potable water has been reported based on pollution and damage to water supply infrastructure due to flooding. Households have also recorded economic losses due to flood. Research has revealed that people are denied job opportunities due to flooding[19].

Impacts of Flooding on the Community

Flood impacts on the community will usually be quite serious and lead to an upset in the operations of the community[19]. This results from the environmental degradation due to flooding. In Nigeria, these environmental impacts have led to the outbreak of water borne diseases, hepatitis, intestinal diseases and malaria[8, 19]. Ibadan is reported as the city most ravaged by flooding at the community level[20]. With the 1st documented flood in 1933, flooding has led to loss of lives and properties in Ibadan even till recent years. Over the years, there has been floods in virtually all zones of Nigeria, with various impacts documented. Some notable cities include Lagos, Makurdi, Kano, Ilorin and Uyo[20]. Several impacts have been reported including damage to farmlands, loss of lives as well as other properties.

Flood Hazard Response by the Government

The exponential increase in flood disasters in Nigeria recently calls for proactive and preventive measures involving both structural and non-structural steps[19].The Nigerian Government, established the National Emergency Management Agency (NEMA) in 1999 with Act 12[27]. NEMA is mandated to respond to disaster victims in a timely manner with relief materials. Over the years, they have gradually improved in the mandate given as reports indicate a very apt response to cases of flood in 2018[21]. NEMA is usually charged with the responsibility of remedying the impact of disasters including flood, on the individuals. Some notable advances have been made by NEMA, including a department on disaster and risk management. Vanguard news reported that the agency has been equipped by the government to ensure proper administration of its duties. Although this progress is appreciated, it leaves a lot to be desired since it is more responsive than proactive.

Also noteworthy, are the flooding forecasts by various government agencies. A remarkable one is the monthly report gazetted by Early Warning, EW, and Bulletin of the West Africa Network for Peace building (WANEP) Nigeria[20]. This bulletin employs an online system to gather information across Nigeria. These online systems involve many early warning mechanisms put in place in the various states to ensure data generation. Further, there has been remarkable warnings from the Nigeria Meteorological

Agency (NIMET), alerting of abnormal weather conditions[20]. NIMET has alerted the country of the risk of above normal rainfall with a bid to allow for a proactive actions against the impending flood.

Although these warnings are issued with a view to a proactive approach, this has not yielded much in Nigeria. The government of Nigeria at all levels has continued to perform below expectation in terms of responding to flood disasters. For example, the 2012 flood was notably severe in Oyo and Lagos[12, 19-20]. Despite requisite warnings by NIMET and WANEP, there was gross failure of the Nigerian government at various levels to take proactive steps to mitigate the effects of this flood[20]. Studies reveal a high cumulative risk index in states that have been most hit by flood. These are in terms of drainage management and urban planning[20]. This is against the background of exponential industrialization, urbanisation, with resultant population increase. These factors have severally led to disorganisation of the affected cities as houses, roads and other infrastructure arise to reduce the surface area for water absorption[19-20].

Although these states are noted with a high risk index, they have quite a low response index, thus the devastating effects recorded. For example, successive governments at various levels in Nigeria have failed to cultivate proper urban planning to match population growth. It is more worrisome that a travel through these cities will show that the city plans have become worse over recent years. We have noticed rapid development in terms of infrastructure to match population growth. However, these developments have not been matched by adequate planning in terms of drainage channels and others[19]. In Lagos, flooding has been blamed on inadequate or outright absence of appropriate drainage channels[19]. This is clear as most major drainage canals have become filled by improper waste disposal methods. This was again blamed for numerous loss of lives during the last blast in Lagos.

Drought and Its Causes

Drought is an environmental disaster that has attracted the attention of many experts. It is usually associated with reduction in precipitation over a period of time[10], prolonged periods of dryness, high temperatures and evaporation, very low humidity, and reduced streamflow and reservoir water levels[11]. Drought may be reported in all climatic zones and not restricted to low rainfall zones. Drought is a slow onset of natural disaster with the ability to affect farming livelihood[23]. Drought has led to losses estimated at billions of dollars in the United States[11]. Drought lasts between 2 and 4 years and could be successive if not well managed. This natural disaster is encompassing, affecting both surface and underground water sources[14].

Drought has been defined in various ways depending on the variable causing the drought[10]. When precipitation is the variable analysed, the drought is classified as Meteorological Drought which result from of lack of precipitation or rainfall over an extended period of time. Similarly, drought is

Hydrological if there is a period with inadequate surface and subsurface water resources for established water uses. The variable applied in determining this type of drought is usually streamflow. Agricultural drought is another class and usually involves a decline in soil moisture with no link to surface water. This causes reduction in crop production.

Further, there is socio-economic drought. This describes the failure of water resources to meet the water demand. This makes water an economic good and thus makes drought a factor in the demand and supply water. Groundwater drought is a case when groundwater systems are affected by drought[10].This happens is stages; usually starting with decline in recharge, level and finally discharge of groundwater.

Understanding the causes of drought is important in risk assessment and remediation[10-11]. Most causes of drought involve climate change and global warming. The natural causes of drought may be grouped into five[25]. These include

- Land and water temperatures: Naturally, increase in temperature will lead to increase in the rate of evaporation based on reduced humidity. Thus there is increase in severe weather conditions that in turn cause more use of water. For example, humans drink more water on hot dry days than on cold humid days and vice versa.
- Air circulation and weather pattern: This is based on the fact that the earth as we know is sustained by a series of cycles. All the water on earth are held in the hydrologic cycle. Thus there is a constant movement of air between the atmosphere and land. Based on weather conditions, this water is cycled in various ways and may result to drought.
- Soil Moisture: Reduction in soil moisture level reduces evaporation of water into the atmosphere to create a cloud. This increases the surface temperature and thus makes drought more severe based on reduced precipitation.
- Rapid population growth: Growth in the population of a region entails a change in the demand and supply of water. Usually, with population growth there is increase in demand for water sometimes exceeding supply. This may become worse when there are other weather conditions that reduce the water resources of the region. For example, climate change and global warming may reduce available water resources. Thus, drought induced by population growth is worse.
- Prevailing seasons: The seasons of a location determine many of its activities. Most times, wet seasons align with farming seasons. This is however not always the case. If agricultural activities of a place do not match the precipitations, there may be a burden on the water resources. This may lead to drought if the resources are not well managed.

Effects of Drought on Sanitation and Public Health

Drought is another consequence of climate change and known to have widespread effects on any society[10], reported in all continents including Africa. The history of drought in Africa dates back to the 1960s with the Sahel experiencing unprecedented drought[10]. The Sahel region of West Africa is known

to be vulnerable to drought. Consequently, this region has been on the receiving end of the effects of drought. This has led to the establishment of the United Nations Convention on Combating Desertification and Drought[22]. The severity of drought in this region is evidenced by effects including famine with at least one drought per decade reported since the 1600s[10].

Notable Public Health effects of drought include reduction in crop yield due to reduced precipitation[26]. This reduction in crop yield could lead to food insecurity and scarcity especially in developing countries like Nigeria. This has led to malnutrition, famine and forced migration. Further, forced migration could lead to health implications resulting from overcrowding, poor ventilation, etc. Another public health issue of drought is lack of potable water. Usually, there is a reduction in the surface, fresh water sources, thus forcing the population to resort to use of underground water resources. These underground water resources are usually contaminated by industrial effluents, sewage, agricultural runoff and heavy metals. The exposure of the population to these underground water sources implies increase risk of waterborne diseases.

Further, there has been reported cases of mental health challenges and resulting suicide because of persistent drought[26]. This mental condition is due to primary effects of drought such as food scarcity, physical health and socio-economic difficulties. Also, airborne diseases thrive more during drought[26]. Usually, during drought there is characteristic dry and dusty condition. This could aid the dispersal of infectious organisms such as *Coccidioides immitis*, the fungus responsible for valley fever[26]. Another effect of drought is more frequent and intense wildfires[26]. This has been implicated for numerous pulmonary and cardiovascular diseases due to inhalation of smoke and particulate matter. This wild fires also deal a great blow to environmental sanitation based on debris and dusts that litter and leave the environment dirty.

Most effects of drought on sanitation are based on reduced supply of water. This will lead to the adoption of measures to conserve water, thus reducing routine hygiene and sanitation practices[26]. This compromise in safe hygiene practices usually lead to the proliferation of diseases. Sanitation conditions as well as the warmer temperatures known to be associated with drought also aids the proliferation of disease vectors[26]. This has been reported in cases of mosquitoes that transmit various diseases.

Measures taken to reduce the effects of Drought

Measures to reduce the effects of drought must be holistic. It is important that actions are taken in a proactive manner with a view to reduce the effects of drought, especially regarding the sanitation and public health of the society. This holistic approach will entail research, interactions and concerted actions. The following measures may help reduce the effects of drought[26]. These measure may be in various aspects. To help alleviate the effects of drought on Public Health involves orientation and advocacy. Physicians and health workers are expected to address their patients on the best ways to protect their health against public health and sanitation hazards of drought[26]. For example, vector borne diseases like West Nile Virus, could be avoided by taking measures to protect transmission by vectors.

This may include the integrated vector control measures. Measures here may include use of repellents, screens and clothing with the intention of preventing the bite of these vectors such as mosquito. Similarly, air borne diseases such as valley fever can also be reduced based on advocacy. This will rely on information issued by experts, to enable individuals avoid hazard areas such as dusty areas. When dust becomes unavoidable, use of indoor filtration and masks could reduce the risk of infection.

It is also important to create mitigation and adaptation plans in response to drought[26]. This will involve the following;

- Taking steps to protect surface and underground water resources from contamination. This may involve using green infrastructure and more environmentally friendly pesticides in agriculture.
- Promoting water conservation practices in cities as well as in Agriculture.
- Ensure safe and reliable public water sources by establishment and promotion of safe drinking water systems.

There is also a need to promote policies and programmes targeted towards a high level of preparedness towards drought. This can be achieved by questionnaires on the assessment of potable drinking water, promoting access to potable water as a human right and setting up safe drinking water systems. This is to ensure safe water for all. Advocacy for improved use of water resources in agriculture and other important areas could help reduce the effect of drought.

Conclusion

The importance of measuring the vulnerability of various communities to disasters cannot be over stressed. This is in view with the increasing frequency of disaster that are contingent on climate change such as flood and drought. It is only with an understanding of the above that progress could be made towards sustainable development. The United Nations has listed a set of goals towards the delivery of sustainable developments by the year 2030.

Nigeria is faced with challenges towards the delivery of these goals in terms of sanitation and public health. The impact of flood and drought in retarding the delivery of these goals is clearly enormous in Nigeria. It is important that all aspects of the society are engaged holistically towards the realisation of these goals. This study reveals that flooding and drought have led to difficulty in the delivery of these key sustainable development goals. For Nigeria to be able to deliver these target goals by 2030, there is need for a reduction in the impact of flooding and drought on the Nigerian public health and sanitation system. This way, the difficult effects will be reduced as we work towards the delivery of sanitation and improved public health by the year 2030.

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