Chapter

Reflections on Climate Change and Public Health in Africa in an Era of Global Pandemic

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Abstract

The study examined the impact of climate change on public health provisioning in Sub-Saharan Africa. In addition to recognising the multifarious influence of climate change on health, it argues that the quest for global health security can only be achieved against the backdrop of concerted mainstreaming of climate change response into public heath provisioning, especially in the developing world. Adapting to climate change and mitigating its impact would logically require integrating it into public health planning, programming and interventions. Therefore, if health security entails provisioning and catering to the full range of health needs of people, climate change given its undoubted implications for health should be in the forefront of health security globally. Despite the global discourse of climate change and health security, tangible actions and programmes at different levels are needed to achieve the goals of good health and effective health security. This is no less the case now that the pandemic has challenged and stretched health institutions and provisions. However, the complex and intertwining effects of climate change and its manifold nexus with public health and health security can easily be apprehended through the systems perspective. There is the need for both radicalization of the public health system in Sub-Saharan Africa and concerted efforts across disciplines and actors to achieve effective climate change mitigation and adaptation and thus further strengthen health security.

Keywords: Climate Change, Sub-Saharan Africa, Public Health, Health Security, Climate Change Mitigation and Adaptation, Pandemic

1. Introduction

The chapter examines the impact and influence of climate change on public health in Sub-Saharan Africa which is a developing region of the world. It contends that in addition to its noted impact on agriculture, the environment, economy and migration, climate change also exerts far-reaching consequences on people's health and occupies a prominent position in any serious discourse on health security. As a result, adapting to climate change and mitigating its impact would logically require its mainstreaming into public health planning, programming and interventions especially in developing parts of the world where public institutions and structures are in most cases incapacitated. In other words, there is no doubting the nexus between climate change and health as well as the various deleterious impacts of climate change on public health [1–3] and health security.

There is no gainsaying the fact that health security entails provisioning and catering to the full health needs of the people in a fair and equitable manner especially against acute health issues that may have global origin and ramifications. In other words, such global events as climate change and pandemics are the main thrust of health security provisioning. Health security thus involves buffering citizens against the present and future threats and impacts of such global events. As argued here, one critical strategy for achieving this goal may be through mainstreaming climate change into public health provision.

Therefore, responding to the new challenges of climate change is certainly a critical way of ensuring health security now and in the foreseeable future. The reassurance that climate change mitigation and adaptation strategies embody provisions for health goes a long way in ensuring health security. Without doubt, building health security niches on the well-known or orthodox health challenges including the explosive issue of COVID-19 pandemic without taking adequate cognisance of climate change is surely deepening health insecurity inadvertently. Therefore, the focus on climate change and public health should be seen as part and parcel of the broad agenda of ensuring health security especially in developing nations where weak institutions and other structural constraints may undermine even the best health intentions.

Be the above as it may, the extant literature is replete with narratives on how climate change affects natural disaster including health related risks for different categories of the human population globally [4–7]. In other words, climate change impacts on natural disaster which in turn leads to fatalities, injuries and other short-term and long-term health issues for affected members of the population.

While some of what passes as climate change may be attributable to changes and transformations in the natural system overtime, a significant contributor to climate change results directly or indirectly from human actions and obtuse inaction. In other words, human influence or activities have been the dominant force of climate change especially the easily observable phenomenon of global warming [8].

There is no doubt that climate change and other human induced stressors negatively influence human health and well-being in various ways. While some of these threats are apparently obvious others are directly observable. However, the impact of climate change and adverse weather events on health is gradually becoming an accepted phenomenon which challenges health policy and planning especially in the areas of public and community health. Thus, while climate change as a distinct phenomenon poses its various challenges there is need for public planners to incorporate climate change issues into the mainframe of health planning. In other words, while climate change calls for adaptation and mitigation efforts, such efforts should be extended and mainstreamed into public health planning especially in the developing parts of the world where public health infrastructure may be commonly weak and bedevilled by structural constraints of different types; which also have a sum negative impact on efforts towards health security whether conceived from a global or national perspective.

Health security even though mainly apprehended from a global perspective equally entails well-planned and systematic action at national and regional levels to deal with global health threatening events. Without doubt, environmental degradation and the increasing consequences of climate change are global concerns that threaten health and which demand concerted action at different levels.

However, assessing the impact of climate change on health, health security and other spheres of national life would benefit from the realization that climate change is not really a single driver of repercussions but is in reality mediated by exiting contextual factors or forces in producing adverse impacts on human life [9]. It is in this regard that climate change response should be context-specific

and targeted at the observed and expected adverse impacts of climate change in any given world region.

2. Methodology

The chapter relied on information from documentary data and the content analysis of extant literature on climate change and health. The literature search was anchored on such inclusive terms as climate change; climate change and health; climate change and public health; health security; adverse weather events; climate change and new and emerging infectious diseases; climate change vulnerability and adaptation; climate resilience; climate change and poverty; climate change and human impacts; health effects of climate change; systems thinking in public health. However, literature with parochial local and solely national focus as well as extreme dated literature were excluded. Sources of literature include: University of Nigeria electronics library collection; IPCC; PLOS; Lancet; Elsevier health; BMC Public Health; Research Gate; and Academia.

2.1 Conceptualising climate change as distinct from weather

There is often a tendency to confuse weather changes or the state of the weather with climate change. As a matter of fact, some of the pessimism around climate change and its implications cohere with a failure to distinguish climate change from weather changes. Therefore, a good starting point in this article or chapter may be to summarily make a distinction between the two phenomena. Even though weather events or changes are related to climate change the two things are clearly different. In a very simple sense, severe weather events like droughts, tornadoes, blizzards, hurricanes and heavy downpours are indicative of adverse weather, climate change occurs in a situation where such adverse weather events persist over long periods of time i.e. over decades or longer. In other words, climate change refers to average weather conditions (in fact, whether adverse or not though emphasis is usually ascribed to the adverse ones for obvious reasons) that have been observed to have persisted or continued over long periods of time.

Thus, while weather state can change over hours and days, climate change occurs only when such events are observed as consistent or increasing in dimension or magnitude over a long period of time usually over decades. Interestingly, climate change in the above sense would encompass both increases and decreases in temperature as well as changing risks and probability of some adverse weather events, shifts and changes in amount and direction of precipitation and significant changes in other features of the general climate system whether globally or in some parts of the globe. But in terms of relationship, adverse weather events graduate to climate change when they are persistent and significant over decades and even centuries.

While vulnerability or susceptibility is a commonly invoked concept in climate change science, it is also a good expression with regards to tackling the climate change effects on human health. In this case, vulnerability becomes the tendency or susceptibility to being adversely affected by climate change induced health effects. However, in the case of public health and climate change, vulnerability is affected by three critical elements viz. exposure (contact by any means between the person and one or more psychosocial, chemical, biological or physical stressors especially those affected or induced by climate change); sensitivity (degree to which the person or group is affected by climate variability or change overtime); and susceptibility to harm or adverse effect which also includes the individual's capacity or ability to adapt or cope [10].

From the point of view of Africa and the developing world in general, adaptive capacity is very critical since the impact of climate change is directly proportional to adaptive capacity of the given group or individual though adaptive capacity is affected in turn by the strength and availability of institutions and common public good beyond the individual. There is no doubt that adaptive capacity also affects resilience or the ability to recover from, absorb and adapt to climate change or adverse weather events. Both adaptation and resilience as already indicated are affected not only by the individual personal attributes and possessions but more crucially by public institutions and policies targeted at engendering climate change adaptation. In this sense, public health as a common good and property of the group becomes crucially in building adaptation and resilience to climate change. While it is right and conventional to limit the public health role in climate change to mainly health benefits, it is equally important to realise that health is pivotal to other manifestations and activities of man in the society. Therefore, building public health systems that are resilient to climate change and which enable adaptation is imperative to improving social functioning in such other spheres as politics, economy, social and culture.

2.2 Theoretical framing of public health response to climate change

There is enough persuasion to believe in the value of the systems approach or systems thinking as a theoretical and philosophical base upon which to anchor public health response to climate change in Africa. However, unlike typical social science notions of the systems approach, the systems approach here privileges the interaction between the natural system and the activities and actions of humans and their agencies. Thus, such natural phenomena as ice sheets, forests, vegetation usually interact with human activities and practices like financial markets, transportation needs, farming systems, public policies and practices, indigenous knowledge, cultural patterns etc. All these cohere with the basic reality that the systems approach allows a holistic and integrative framing of climate change challenges and responses that are anchored on the inevitable reciprocity, mutual impact, heterogeneity and common influence that characterise both the natural and social systems.

The systems approach from one influential perspective is "a paradigm or perspective that considers connections among different components, plans for the implications of their interaction, and requires transdisciplinary thinking as well as active engagement of those who have a stake in the outcome to govern the course of change" ([11] p. 403).

Incidentally, public health is attuned to the realization that health is not solely a question of the bio-medical conditions of the individual or society. It embodies a fundamental recognition that public health is founded on the conception of health as beyond simply the biology and even behaviour of the individual. The above perspective makes it possible for public health to embody perspectives and viewpoints beyond the bio-medical and this is what makes public health suited to tackle the multi-pronged challenges of climate change which requires concerted efforts from different professionals and experts.

Also, the systems approach becomes recommended because it goes over and beyond conventional or orthodox conceptualization and framing of problems and actions. It thus embodies features and orientations that help capture the undoubted complexity of public health and the innovative responses demanded in coming to terms with climate change.

Components of the systems approach that recommends it to public health and climate change concerns include: its emphasis on relationships among phenomena; enables generalised studies even while preaching multidisciplinary orientation;

transcending academic or disciplinary boundaries in the bid to foster effective interaction; apprehending and building robust responses to social issues including climate change, health and even peace building; heterogeneity of philosophical roots and methodological orientation that generally produces a bewildering range of philosophies and array of methodologies that are extensive enough to embody different aspects of public health and generate innovative responses and framing new challenges like climate change. However, underlying and coupling the unique features of the systems thinking in public health is the emphasis on information sharing, collaborations across disciplines, active borrowing from others; eclectic orientation to both philosophical roots and methodologies; co-production of knowledge and more critically openness to new ideas and methods in spite of disciplinary orientation.

Beyond the above, the systems approach allows the conceptualization of both climate change and public health beyond a one-dimensional or uni-disciplinary perspective. It makes us realise that the public health challenges of climate change necessitate both concerted actions and the breaking of disciplinary barriers.

But the systems approach while lending itself to robustness, innovation and transcending of disciplinary boundaries or its eclecticism still enforces academic rigour and methodological sensitivity as we pursue understanding and solutions to health challenges including climate change. In this sense, "systems thinking compels us to study complex health-related phenomena rigorously, but with appropriate techniques" ([11] p. 404).

2.3 Climate change and health: an established and evolving nexus

It is really matter of fact to argue that, "public health planners and professionals at the state and local level, policymakers, and members of the public all need to consider health a central dimension of climate change and to plan and act accordingly" ([12] p. 435). In this sense, climate change does not just require framing into health planning but equally calls attention to the need for concerted action across all sectors in order to evolve adequate and timely responses to climate change especially in the area of health where the multifarious impacts of adverse weather events on health are still emerging.

In other words, while there is incontestable evidence of the impact of climate change on a good number of health issues, there are still emerging evidence of further nexus between adverse weather or climatic conditions and human health. The above reality underlines the need for a public health response that is both innovative and encompassing.

There are so many ways that climate change impacts on health. Thus, such things as the survival and distribution of mosquitoes, ticks, disease carrying rodents and the general environment (droughts, floods, and environmental hygiene) are all affected significantly by weather events and climate change. Also, climate change and weather affect the survival and distribution of helminths and their implications for such health issues as nematodes or roundworm infections (lymphatic filariasis, onchocerciasis); soil transmitted helminthiases; trematode infections (schistosomiasis and others); cestodes or tapeworms that cause a broad range of infections and diseases in human hosts.

Apart from the above, such other vector borne diseases like malaria and Dengue fever are proliferating from increasing climate and weather adversity in Africa while meningitis or Meningococcal meningitis which is caused by the bacteria *Neisseria meningitides* is also a climate sensitive disease which even though existing globally takes it heaviest toll in Africa and other developing parts of the world. Thus, there is no doubt that quite an impressive array of evidence exists in the extant literature

on the real and potential health effects of climate change globally [10, 13–16]. As already established a climate change induced event like drought can be linked to such illnesses as diarrhoea, scabies, conjunctivitis and trachoma [17].

Some easily verifiable negative health implications of climate change include (**Table 1**).

2.4 Specific nexus between climate change and pub health in Africa

There is no gainsaying the obvious fact that climate change can impact on public health in Africa in a variety of ways. Thus, "climate change effects on human health, along with the additional impact on the environment and on the economies of African countries, are likely to impede development. African countries will suffer health consequences related to the effects of climate change as their people are among the most vulnerable to climatic change in the world. This vulnerability is due in part to existing problems of poverty, weak institutions and armed conflict" ([18] p. 1). Therefore, peculiar African challenges ranging from widespread poverty, weak and failing institutions, internecine conflicts to poor public health systems, weak governance, and leadership incapacity make the continent literally in the eyes of the storm with regards to climate change. Confronting climate change and adverse environmental factors would entail improving and enhancing social and governance systems and processes.

As, as has been contended, "climate change can therefore affect human health in two main ways: first, by changing the severity or frequency of health problems that are already affected by climate or weather factors; and second, by creating unprecedented or unanticipated health problems or health threats in places where they have not previously occurred" ([10] p. 31). Specific nexus between health and adverse climatic conditions is illustrated in **Table 1** below.

In summary, climate change in Africa would adversely affect water resources (floods and droughts); severe decline in precipitation especially in South Africa and the Southern Africa region; increasing extreme and longer heat periods especially in tropical West Africa [19]; agricultural production especially cereals [20]; savannah ecosystems [21]; increased aridity in the Southern Africa region especially Somalia

S/N	Health Issue	Adverse Climatic/Weather Event
1.	Hypothermia	Cold
2.	Hyperthermia	Heat (including heat waves and heat stress)
3.	Famine	Droughts; Floods
4.	Internal Displacement	Floods; Drought
5.	Personal injuries	Floods; Hurricanes; Wildfires; Tornadoes
6.	Death (including drowning)	Floods; Droughts; Wildfires; Landslides
7.	Vector Borne Diseases (malaria; dengue fever; rift valley fever)	General adverse climatic conditions especially precipitation; floods;
8.	Food contamination and shortages (impact on nutrition and disease resistance)	General adverse climatic conditions especially precipitation; floods;
9.	Emerging Infectious Diseases (West Nile virus; Ebola; hantavirus)	General adverse weather and climate
10.	Cardiovascular and respiratory diseases	General adverse weather and climate

Source: Author's compilation.

Table 1.
Specific health issue by adverse climatic/weather event.

and Ethiopia; ocean ecosystems especially in the form of declining fish catches; coastal populations; general infrastructure and myriad health issues ranging from infectious diseases (resurgence of New Tropical Diseases (NTDs), variants of known viruses) to fatalities and injuries resulting from adverse climate events like flooding, landslides and heavy rainfall [22].

The notable impacts of climate change in major regions in Sub-Saharan Africa include: West Africa – droughts, flooding in coastal plains, desertification, severe food production decline and food shortages with implications for health across varied groups [23]; Southern Africa – droughts resulting from decrease in precipitation, new and emerging vector borne diseases; East Africa – flooding, health risks and infrastructure damage. All these consequences would be seriously further worsened by poverty and incapacity of institutions. For instance, it has posited that the populations of such African nations like Mozambique and Nigeria would be most affected by sea-level rise in the future in terms of absolute number of those to be affected [24].

Climate change would also expectedly occasion a shift in the distribution of a good number of vector-borne diseases. In fact, it would appear that malaria is already encroaching in areas hitherto alien to it including the highlands of Ethiopia, Kenya, Burundi, Rwanda [25–27]. These areas are usually where malaria was not in existence a few years ago. Worrisomely, such projected shifts would also affect areas of the Sahel, East Africa as well as Eastern, Central and Southern Africa.

Perhaps, the specific role of public health in climate change adaptation and resilience can be further illustrated through a brief focus on three adverse weather events that are now almost rife in the continent viz. drought, flood, and wildlife:

Drought – the function of public health in this regard should commence with a thorough risk assessment which should normally focus on such critical health issues as sanitation, water, food security, shelter as well as such other structural considerations as the likely or probable political, economic and psychosocial impacts of the drought on a given population or community. All the above are contingent upon recognising that drought can produce the following adverse effects: contamination of water; compromising sanitation and hygiene facilities and activities, infections, and population displacement. Thus, activities should focus on how to stem, ameliorate or avoid the impact of the flood on the above and generating disease surveillance, infection control, temporary shelters and alternative water sources tailored to the drought in question. The activities also require both public education and information regarding water usage, specific social and health risks as well as behavioural and attitudinal orientation consistent with adapting to and overcoming the adverse event. There is no doubt that information even before, within and immediate cessation of the drought can go a long way in the quest for resilience.

Floods – floods entail the overflow of water or the submergence of normal land areas with water. Floods could result from excessive precipitation over a long period of time; the overflowing of rivers beyond their banks; streams that occasionally break their confines or limits and submerge neighbouring areas. In the above sense, flooding may be caused by either natural processes (excessive rainfall; massive melting of snows) or coastal processes (storm surge as a result of hurricanes; tsunamis; inundation of the coastal regions; excessive water currents).

However, apart from the tsunami, the other causes of flooding are directly related to climate change and can be made worse by human activities related to land use, farming, irrigation activities etc. The public health impacts of climate change induced flooding include: destruction of homes; population displacement; water contamination; personal injuries; stress and mental health issues; disruption of both sewage and waste disposal as well as death (either from drowning or other activities related to the onset of the flood or during the flooding).

Public health response to flood would include precautionary and early warning systems. Equally important are strategies and detailed action plans that anticipate the impacts and emerging needs to be produced by the flood as well as peculiar stop-gap approaches to tackle shortage of services and amenities within the flood period. These could be related matters like loss of shelter, personal hygiene, general sanitation, water, worsening of pre-existing chronic diseases, over-burdening of existing health-care facilities, likely increase in disease burden, onset of new and emerging infectious diseases especially at the cessation of the flooding or during it, loss of income among others. In sub-Saharan Africa in general, floods always increase the likelihood and burden of diseases like malaria and Dengue fever. Thus, there may be proliferation of mosquitoes and other vector borne diseases resulting from the flood. Incidentally, the impact of these health issues goes far beyond the cessation of the flood.

Wildfire – Even though not as much a problem in Africa as it has been in the United States since the last two decades, wild fires still pose considerable climate change challenge. Generally, wildfire is a humongous inferno; a large sweeping and destructive fire or conflagration which occurs especially in the rural areas and desert or wilderness. Wildfires usually poses a lot of adverse consequences for the affected population or community ranging from the probability of burn injuries, death, population displacement and loss of property. Just like in the case of the flood, the normal first step for public health agencies should be community wildfire risk assessment and evaluation of fire hazards within the community. There should be extensive and full plans relating to probability of wildfire and the fire hazards. Plans would involve the specific steps or strategies for evacuation and regular fire drills as well as mass evacuation and temporary resettlement plans.

2.5 Generalised poverty, climate change and health in Africa

One big problem with addressing climate change impacts especially adaptive capacity of household and individuals in sub-Saharan Africa is that of poverty. In spite of however poverty is defined and whatever indicators are used in measuring it, there is no contesting the fact that poverty is widespread or generalised in most countries in Sub-Saharan Africa. According to a recent World Bank Report [28] people living in poverty in Sub-Saharan Africa grew from 278 million in 1990 to 413 million in 2015. Furthermore, the average poverty rate for the region is about 41% and 27 out of the world's 28 poorest countries are in Sub-Saharan Africa [28, 29].

Poverty limits individual's economic and social functioning and exerts adverse impacts on nutritional intakes, access to health services and even sensitivity to climate change and adverse weather events. The poor are usually in the epicentre of impacts of climate change because those who are poor suffer generalised socio-economic debilitations and inadequacies even before the onset of climate change. Therefore, in the event of climate change adversity the poor are usually the first affected and the most impacted. As has been argued, "poverty can leave people more exposed to climate and weather threats, increase sensitivity because of associations with higher rates of illness and nutritional deficits, and limit people's adaptive capacity" ([10] p. 31). For instance, it is reported that malnutrition cause about 1.7 million deaths per year in the continent and is perceived as the largest contributor to mortality related to climate change around the world [18].

2.6 Refocusing and strengthening public health response to climate change in Africa

The response of public health to climate change should go beyond the usual focus on epidemiology and diseases prevention and control to anchor on social

framing of health issues and engendering appropriate behavioural and attitudinal responses in the public. In this sense, health workers and professionals should embody strategies towards motivating appropriate behaviours in people as well as the political capital and tool for eliciting innovative policies especially from political leaders and policy makers.

Public health should in terms of climate change focus on the promotion of safety and health (parts of its core mandates). It should ideally work towards reducing the pre-existing burden of disease and evolve activities that build social capital, community engagement and collaborative initiatives that enhance community resilience. From the point of view of responding to climate change challenges, the preparedness and response of public health institutions should enable activities that build community resilience as well as reduce vulnerability in the population [30].

In other words, while climate change reverberates with health security, its challenges can be approached from a robust public health system that facilitates both mitigation and adaptation processes. Thus, the relationship between health of the people and climate change within a public health framework can be depicted in a Venn diagram as shown below (**Figure 1**).

There is no doubt that intervention in climate change adaptation is clearly in the core mandate of public health. Therefore, focusing on the public health impact of climate change is really consistent with key medical ethics of beneficence (protection of people from harm now and in the future and more generally in terms of boding good for people), non-maleficence (avoids harm or injury), and justice (equitable and fair to all concerned). The problem or issue of justice resonates with health provision even prior to climate change given noted inequalities in health. These inequalities are especially heightened in the case of Africa and other developing parts of the globe where economic and social limitations negatively impact

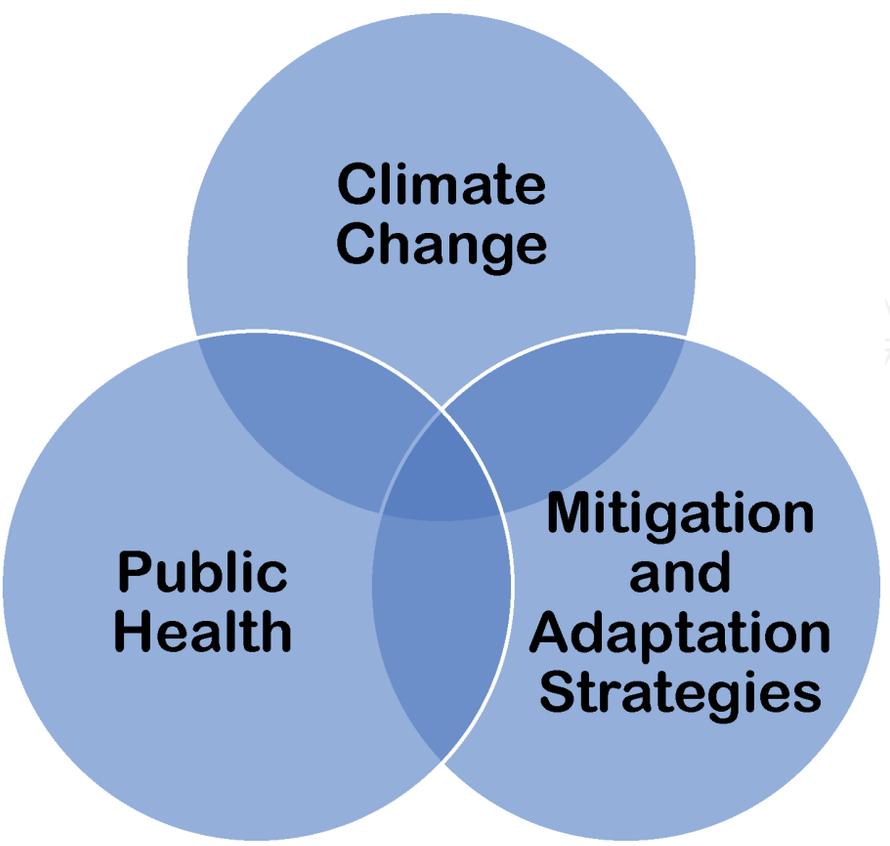

Figure 1.
Nexus between Climate Change and Public Health. Source: Author's compilation.

peoples access to health and health facilities. As has been insightfully posited, people in poor countries will willy-nilly face more health risks in the context of limited resources and thus less resilience than the situation in the developed or wealthy nations of the world [31–34]. It is a given that climate change has the tendency and potency to exacerbate existing health disparities and even introduce new ones. Incidentally, health disparities and inequalities are imbued in public health; and public health practices and policies aim to eliminate these disparities. These overriding goals of public health are more than desired now that climate change poses a formidable challenge to the health of people in these developing regions of the world. In these areas more than any other place, "public health action on climate change must include vulnerability assessments, identification of the most vulnerable populations, and a focus on eliminating health disparities" ([12] p. 438).

It is conventional wisdom that one approach to climate change is to improve the adaptation and resilience of people to adverse weather events. Adaptation to climate change incidentally occurs mainly at the individual, family and community levels. As a result, public health agencies and institutions given their location at the local communities are especially in a position to build the resilience of people to climate change especially climate change induced or generated disasters and afflictions. Public health institutions should be core part of the preparedness, response and recovery activities associated with climate change. In other words, public health agencies with their felt presence in the local communities can play critical roles at the three levels of building resilience to climate change.

Preparedness focuses on anticipating and making provision for the impacts and influence of climate change on people (activities and programmes that build and improve absorptive capacities); response has to do with a robust and timely response to the emergencies and problems that arise in times of adverse weather events like floods, wildfires and hurricanes (creating and deploying buffers that stunt or stop the influence of adverse events); and recovery is all about enabling the prospects and processes of overcoming the effects of adverse weather events at both the individual and community levels (activities and strategies towards engendering and facilitating recovery from such events in the community).

A very pragmatic approach to the evolvement of good practices and behaviours among the populace may be also emphasising co-benefits of health which have undoubted utility to climate change efforts. There is no gainsaying the fact that actions which embody health co-benefits (i.e., other benefits and gains beyond climate change) would more likely induce behaviour modification and attitude change than those that simply target only climate change issues which incidentally exist mainly on collective and aggregated forms. These issues are often construed as beyond the immediate influence of the individual; a view which often debilitates action on the individual level against climate change.

Responding to climate change would entail of necessity both innovation and radicalization of some conventions of policy and practice. For instance, climate change requires a longer time frame in public health planning than is usually the case [35]. Research is actively needed in order to continue to refine approaches to tackling the peculiar and general health challenges of climate change; also, to discover new and emerging nexus between adverse weather events and health. In other words, there should be endless quest for new evidence and innovative solutions. New evidence of association, whether in the short or long run between climate change and health as well as exerting efforts and resources on discovering innovative solutions to climate change induced or enhanced health challenges.

Interestingly, while preparedness is critical to public health interventions in climate change, it often occurs within the context of scientific uncertainty and inadequacy of facts. Thus, such events as pandemics, hurricanes and even tornadoes

cannot be predicted with precision, public health is expected to be innovative and prepared enough to respond within a limited time frame. It is in recognition of the above that preparedness is all about anticipation. This preparedness or anticipatory strategy finds support in both conventional wisdom and scientific orthodoxy. Thus, according to the Wingspread Conference, "when an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically" [36].

Preparedness would therefore compel public health agencies to act or think strategically even when there are not enough or satisfactory precise scientific evidence. This would involve an element of risk management. Risk management as the name suggests is the systematic and evolving efforts towards identifying, tackling and reducing perceived risks to the health of a given population. Both the risk management principle and strategic thinking embodied in the notion of preparedness derives from the cognition that climate change could exert enormous costs on health but this could be significantly reduced if adaptation and mitigation efforts specific to health are undertaken at the onset. Therefore, "timely action to address the health impacts of climate change and makes good economic sense" ([12] p. 437).

3. Conclusion

Apparently, the discourse on climate change and public health does not seemingly embody health security. However, the above view is only tenable when health security is given a narrow or circumscribed definition and approached from a climate sceptical stance. But health security is concerned with all actions and systems that portend good health and wellbeing of citizens now and in the future. Thus, responding to the nascent health challenges of climate change within the framework of public health should be rightly conceived as crucial to realising the broad goals of health security. After all, health security as generally acknowledged is about actions and activities that are needed whether proactively or otherwise in order to curtail or minimise the impact or deleterious effects of acute or serious health events. In its conventional sense, health security is approached from a global perspective that privileges concerted action at different levels. In the same vein, climate change issues have been approached largely from a global perspective and have been perceived as portending acute public health challenges globally. However, while global efforts remain paramount, actions at regional and sub-regional levels can be coordinated in the case of climate change to build into the global health security agenda.

As part of the effort at adaptation and strengthening health security, public health should actively and robustly link people to needed and appropriate health service and support in the event of adverse weather events. Therefore, there is need for a strong and integrated infrastructure for delivering health service and interventions as part and parcel of the response to climate change at the community level. As has been argued, "climate change, an environmental health hazard of unprecedented scale and complexity, necessitates health professionals developing new ways of thinking, communicating, and acting" ([35] p. 403).

Besides the recent global challenge of COVID-19, climate change has been in the forefront of realistic efforts towards health security in the past three decades. Thus, climate change and its responses should be seen as lying squarely within the rubric of health security. Apparently, there can be no real or sustainable health security especially in developing regions of the world without accounting for climate change. Putting climate change within a responsive and robust public health system

logically responds to the glaring need for health security in almost the same way as a global compact on COVID-19 and its vaccines.

A good theoretical landing in responding to the health challenges of climate change is through adopting the systems theory. Systems thinking in this regard embodies multi-disciplinary and linkage propensity in the sense that it is oriented to drawing a nexus between disciplines. Therefore, in public health and climate change the systems approach become relevant in ensuring linkages and manifold nexus between disciplines that breeds concerted action. Without doubt, climate change is the area where multi-disciplinary approaches are needed in order to fully embody and respond to its various impacts and manifestations. Systems thinking also privileges diverse impacts and manifestations. It thus enables the understanding and acceptance of the impacts of both climate change and health on other spheres of the social system.

In spite of accelerating research on climate change in the last few decades, there is still no contesting the need for more research efforts especially in pinpointing specific and directional interaction between climate change and health or diseases especially in the case of new and re-emerging infectious diseases in Africa. In other words, nothing would be better than an evidence-based response to climate change i.e., the use of research and experience of epidemiology and disease patterns over the years in designing and informing climate change response in the area of public health in the continent. Despite the above, there is no gainsaying the need for radicalization of the public health systems in Africa and repositioning them towards innovative and concerted response to real, emerging and even anticipated impacts of climate change on health. These would entail not only fundamental mainstreaming of climate change into public health but equally building individual and community resilience through programmed interventions; tackling extensive health inequities or disparities especially those generated by or associated with poverty as well as reforming health institutions and infrastructure to embody robust innovations and concerted response to climate change especially in this era of global pandemic and beyond.

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