Implication of global climate change on human health and its environment: Possible adaptation strategies

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ABSTRACT

There are evidences everywhere that the earth as a planetary body is at risk of gradual deterioration. The global climate is changing thus bringing about negative and significant hazards on human health and its environment. This occurrence implies that human are altering earth natural, ecological and bio physical systems that has keep the lower atmosphere and earth’s surface even warmer. The rapid increase in environmental degradation daily experienced by human and ecosystems has become an issue of extreme importance to researchers. Presently, recent studies has shown that some parts of the world are experiencing increase in the number of hot days, intense climatic and environmental threats due to extensive use of greenhouse gases. The aim of this paper is to extensively review the potential health impact of global climatic change and enumerate methods to protect human from risk associated with this phenomenon. Possible adaption responses are reviewed to increase the level of human adaptability with the unavoidable catastrophe posed by climate change. This study further explains how to reduce human vulnerability and different adaption strategies to improve public health.

Keywords: Climate change, implication, environmental degradation, greenhouse gases, adaptation strategies, human health.

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INTRODUCTION

Climate change has always been influencing human-health thereby affecting all sectors of the society both globally and domestically, changes in climate and weather threatens human well-being and exposes our health to unfavourable conditions associated with extreme weather events such as droughts, flooding, storms, rise in sea level, and increase in precipitation warming temperature (IPCC, 2001).

This is an exorbitant occurrence that is presently affecting the planet earth in diverse ways and the effects are being felt everywhere around us. Climate Change is also evident by increase rate of precipitation, rising sea level, (WHO, 2009) depletion of fresh water bodies, biodiversity losses decrease in global food production and availability, pressure on marine and terrestrial biota. Most of human activities trigger global climate change and impact changes to physical, biological and ecological, socio-economic system thereby making life difficult for human to survive.

According to IPCC fourth Assessment Reports (IPCC, 2007a) the climate has undergone a significant warming. This change is possible to have potential influence on human living. The use of greenhouse gases such as nitrous oxide, methane, carbon dioxide, water vapor absorbs heat energy into the stratosphere and emits it to the earth surface. High concentration of GHG has increased the ozone layer emission and altered the earth planetary covering (stratosphere) thereby releasing ultraviolet radiation into the earth’s surface.

Global temperature has increased by approximately 0.6°C (10°F) over the last century and the intergovernmental panel on climate change concluded that majority of the warming over the past 50 years is likely due to human pressure on the environment (Houghton, 2001). Despite the reduction in the use of greenhouse gas emission, climate change has been
projected to continue for many years as a result of both natural influence and human activities (WHO, 2003).

The implication of climate warming as it exacerbates, makes human to be vulnerable to present and future environmental challenges. These adverse effect are either directly (e.g. impacts of heat stress, suffering from drought and storms, death through flooding) and indirectly through changes in the widespread of disease vectors, food availability, water and air quality (WHO, 2003).

Outbreak of infectious and non-communicable diseases, threats to wildlife, losses in biodiversity, deflection of freshwater supplies and other common epidemic health challenges calls for urgent attention of research task (IWGCCH, 2010). These impacts threatens our health and livelihood by affecting the food we eat, water we drink, the air we breathe and the weather we experience (EPA, 2017). Our ability to adapt to changes will also depend on where people live, how sensitive each persons are to health threats, how much they are exposed to climate change effects and how well the susceptible regions can cope with change (EPA, 2017).

Developing countries are likely to be the most vulnerable to health risk but climate change also poses significant threats to people in developed nations. The rate of human vulnerability to disease in both developing and developed nations is still very high. People that are most affected are children, older adults illiterates and households that are economically poor and disadvantaged. Poverty contributes to the rate of human susceptibility to global climate change.

Implication of climate change may likely differ across population and are environmental conditions of these populations and the associated human and social consequences with other determinant that include available resources, capacities, existing behaviors and attitudes of these population (EPA 2017).

Although, most weather events cannot be totally eradicated, adaptation strategies are needed to protect public well-being and human health whether or not actions are taken to prevent the effects of climate change on human. Different research work has shown that the rate of global warming may not be sufficiently slowed down or eradicated to minimize predicted climate change as a result of this; proper measures should be implemented to curb already prevalent climatic influence on public health.

Climatic balances has been adversely altered by inappropriate use of land (Watson et al., 1998), release of organic pollutants affects the amount and type of particles in the air, burning of fossil fuels, industrial and household use of aerosols also leads to large amount of CO₂ gas in the atmosphere. Most of human diseases nowadays are directly or indirectly associated with climatic disorder. Lots of human settlements have limited access to safe drinking water, inadequate crop yield, poor sanitation and restriction to land use. These have significantly contributed to poor human health, economic and societal development. Most human settlements are infected with diseases pathogens which are distributed by climate change and environmental pollution.

Studies have indicated that climate change impacts have received a minimal attention for past years in areas of strategic implementation and research. Attention needs to be shifted on how to counteract widespread of epidemics and how human health can be thoroughly managed to secure future generations from adverse climatic effects.

**METHODOLOGY**

This paper was extensively reviewed from recent literatures, technical reports and workshops and recent publications on global climate change. The paper further enumerates adverse impacts of climatic-sensitive disease on public and human health. More information was extracted from online/ internet based research Questions were asked from physically displaced people that has been affected either by flooding, drought or other weather conditions on how they have been able to adapt to sudden change of livelihood. Medical practitioners were also interrogated to know common climate related health challenges and complaints in different hospitals. The review paper has properly been written to discuss how human health can best be managed even in phase of continuous climate change. The widespread of most of the diseases discussed in this review work depend largely on influence of climate change.

**DIRECT EFFECTS OF CLIMATE CHANGE ON HUMAN HEALTH**

**Water quality**

Changes in rainfall pattern and other precipitation, temperature changes, melting of summer ice-bergs are already occurring and will create changes in the availability and quality of water across the planet over the next 30 years (IPCC, 2007b).

Water quality is also affect in many regions particularly coastal areas, due to extreme weather events such as hurricanes and flooding. This events are associated with rising in sea level and increase in storms which can heavily damage human communities infrastructures and alter ecosystems with consequences for both water and food quality supply.

According to Intergovernmental Panel on Climate Change (IPCC, 2007), the United State water resources availability for drinking, agricultural purposes and other uses is becoming a pressing issue. This is particularly true in the Western half of the country, where water shortages are exacerbated by reduced mountain
snowpack due to warming, and in the south were severe drought have become a more frequent occurrence in recent years (IPCC, 2007).

**Air quality**

Changes in heat, humidity, degree of UV radiation and many other factors can directly reduce outdoor air quality particularly in urban areas, by increasing air concentration and human exposures to various toxic air pollutants like chemical fungi and aero allergens. When human are exposed to variety of these pollutants, it results to increase in asthma, cardiovascular diseases and respiratory ailments. Extreme heat also directly increases the risk of injury, illness, and death; as well indirectly contribute to illness associated with mental health and stress (Noyes et al., 2009).

**Ecosystem**

Extreme heat in certain arid and semi-arid part of the United States can drastically alter existing ecosystem, presenting new challenges to crop production and coastal ecosystems which have adverse effect on food quality and availability. Climate changes are directly associated with many pest habitats and diseases vectors. Global warming is also causing shifts in the ranges of disease vectors that require specific environment to survive for example Lyme disease (Estrada-Pena, 2002) and increasing human threats on water and vector borne diseases and zoonotic diseases (those transferred from animals to human). Changes in plant habitat can result in reduced availability of grazing lands for livestock (Ericksen et al., 2009).

**Oceans**

The oceans regulate global climate; they mediate temperature and drive the weather, determining rainfall, droughts, and floods (https://www.worldwildlife.org). High concentration of CO2 from greenhouse gas emission into the atmosphere increase the amount of CO2 that is dissolved into the ocean leading to disruption of ecosystems and acidification (Altsop et al., 2009)

Recent report from UCSUSA 2019, discussed that pollution from atmospheric carbon can retard ocean ability to uptake CO2 causing more harms to shellfish and other aquatic mammals (https://www.ucsusa.org/resources/CO2-and-ocean-acidification).

Increase in temperature leads to warming of ocean waters and this contributes to increase in incidence and severity of toxic algal bloom, alteration in marine bodies, estuarine and sea foods, poor food quality and availability. Certain alga species has the potential to release toxins that can cause adverse health effect on the liver and nervous systems of human and wildlife. This degrades both aquatic ecosystem and public health (EPA, 2013).

**Weather**

Weather and climate change are complementary factors that have been known to affect human health for past decades now.

Changes in extreme weather and climate events such as heat waves and drought, are the primary way that most people experience the impact climatic change (National Climate Assessment: USGRP, 2006). Intense heat causes skin burn and hyperthermia in some parts of the world while cold causes hypothermia (Reuler, 1978). All these health disorder are as a result of weather degradation, drought causes famine, injuries, displacements and death results from tornadoes, flooding, hurricane and forest fire (Westerling et al., 2008). Change in weather condition also affects the risk of food-borne and water-borne diseases and of emerging infectious disease such as hemorrhagic fever, Ebola and West Nile Virus (Rainham, 2005). This phenomenon contributes to widespread of malaria, fever and plagues.

**Possible adaptation strategies to reduce climate change**

Adaptation strategies actions that needed to be taken to reduce adverse effect of climate change that is observed today and prepares us for its implications occurring in the future. Efforts must be adopted to improve human standard of living and adjust the public to health-related problems from global climate change (Spickett, 2007).

This adaption measures is a shared responsibility. Government at all levels, business areas and households has complementary roles to play (Department of the Environment and Energy: Australian Government, nd). Adaptation reduce rate of vulnerability of human into climate impacts and its needed everywhere but more urgently in areas that are more exposed to climate change and have less adaptive capacity (Adaptation Policy in European Union - An overview, 2008).

Deliberate policy decisions can be carried out by both private and public sectors to disseminate information on threats that climate change imposed on health and implement a global research (WHO, 2018).

Specific options are available to every sector to respond to climate change adaption.

**Water-related sector**

Using scarce water resources more efficiently, expansion of rainwater harvesting or storage, state and regional
Climate change due to human activities

Global warming and climate effects are one of the biggest crises facing humanity today. It is not only humans that are affected. Some wildlife habitats around the world are becoming less hospitable to animals due to forest wildfire, deforestation and food security is already being impacted in the number of some African countries and people are displaced by rising sea level, high rate of perspiration, extreme increase of temperature and other atmospheric conditions (climate.change.environment.nsw.gov.au). More human-induced greenhouse gases have increased the earth temperature over the past 50 years (IPCC, 2014). These gases are trapping heat in the lower atmosphere as observed that these result in a cooling in the upper atmosphere and a warming at the surface and in the lower parts of the atmosphere (Lockwood et al., 2009).

Health sector

Primary Health Care and community based programs, sanitation, facilities, disaster-proof and health care facilities, immunization, personal protection for example: the use of mosquito net and human case surveillance and monitoring (UNFCCC, 1992).

The well-being of a community must be prioritized to sustain human health and give universal access to quality services which is fundamental to public health, but many still lack equal access to health care in most developing countries (WHO, 2000). There must be sustainable prevention and control program against non-communicable and infectious diseases.

Infrastructure sector

Infrastructure can be adversely affected by climate especially in extreme events such as flooding and hurricanes; therefore economy self-interest would encourage property owners to erect bulk heads in order to protect coastal properties. These bulkheads would otherwise prevent formation of new wetlands from offsetting the loss of wetlands that are inundated (Titus et al., 1986).

Responses to erosion and flooding due to rising sea level should be in erecting walls to hold back seas, and allow the sea to advance and adapt to land raising (EPA, 1989). Provision of essential services and infrastructures by government and private providers should be adopted.

Air quality:

The spread of air particles increases chances of human vulnerability to respiratory disease and infections. There should be self-protection capability, air quality management programs, medical treatment and services should be continuously improved to reduce human risk to respiratory disorders, asthmatic problem and nasal congestion among children.

Food sector

More ecological research needs to be carried out on drought tolerant plants. Regulation and policy on land use system, new cropping practices, agricultural management are needed for food security and high productivity for human consumption. Soil protection against climate change can be achieved by thorough management practices to conserve the organic matters and nutrients. Improved soil management, efficient energy and water efficiency by irrigation are useful for ecosystem services (UNFCCC, nd).

Ultraviolet exposure

Legislative or regulatory strategy by government should be planned to control the use of greenhouse gases in various industries and environmental friendly gases should otherwise be produced for industrial and household use. Also, individual choices have the potential to reduce greenhouse gas emissions to improve human health benefits. For example cleaner energy systems and reduction of vehicle miles travelled will reduce ozone precursors like Carbon Oxide thereby reducing health risk associated with allergies (Woodcock et al., 2009). Alternative transportation options such as walking and bicycling will reduce toxic emission and increase cardiovascular fitness (Woodcock et al., 2009).

Adapting building codes and landscaping ordinances are likely need to be updated not only for energy efficiency but also to conserve water supplies, protect against dramatic weather disorder and reduce vulnerability to extreme heat stress. Building flood defense and raising levels of dykes. Afforestation, public education programs, energy efficient buildings are realistic adaptive measures. Therefore, regular assessment by government sectors and financial supports are extensively needed for all these strategies to be implemented.
Greenhouse gas such as methane CH₄, CFC, HFC, CO₂ and H₂O vapor enters the atmosphere through, industrial applications, fossil fuel exploration and home appliances like Air conditioners, refrigerators etc. All these cause stratospheric ozone layer depletion, warmer temperature in the lower atmosphere, severe drought to health-threatening snowstorms, extreme winter weather resulting to anthropogenic climate effects (www.wiredco.uk.2018).

Carbon dioxide is a very important component of the atmosphere and is being released through natural processes such as volcanic eruptions, respiration and through human activities like land use changes, deforestation, burning fossil fuels (C oil and oil burning) combines O₂ with C in the air to make CO₂ (IPCC, 2014).

The industrial activities that civilization has brought about have raised atmospheric levels from 280 to 400 ppm in the last 150 years (IPCC, 2014).

Since industrial revolution has begun, atmospheric CO₂ concentration has increased by one third (NASA, 2019).

Water vapor is not directly influenced by human activities. It is related to changes in the earth’s temperature. Although it does not accumulate in the atmosphere but it absorbs heat which affects the weather conditions.

Deforestation has reduced the amount of plant life available to turn CO₂ to Oxygen. This comes in many forms it can either occur by natural fires, agricultural clear cutting, livestock ranging, and untenable logging of timber which threaten tropical forests, their biodiversity and the ecosystem services they provided.

**CLIMATE-ASSOCIATED DISEASES ON HUMAN HEALTH**

**Water-borne diseases**

Climate change significantly affect water supplies with high devastating impacts on human. Fresh and marine water resources are affected by this change and otherwise increases human’s exposure to water-related contaminants that cause illness (Trtanj et al., 2016). It has been reported by Reynolds et al. (2008) that water borne diseases are caused by pathogens such as bacteria, viruses and protozoa and these pathogens are estimated to cause 8.5 to 12% of acute gastro intestinal illness cases in the United State affecting between 12 and 19 million people annually.

Human are vulnerable to vomiting, diarrhea, stomach disorders and severe cholera disease in much cases. Use of fertilizers sediments and debris flow, high rate of precipitation, humane run off and flooding are major water contaminants.

Water-borne diseases are also induced by toxicants produced by certain toxic algae growth and chemicals that are introduced by human activities.

**Air-borne disease**

The use of organic air pollutant like pesticides, mosquito repellants, black carbon from exhaust pipes, expose human to illness.

Warmer temperatures and weather variability can worsen air quality which leads to traumatic respiratory and cardiovascular health effect (Crimiminis et al., 2016) such as breathing, irregular asthma, coughing, premature death in severe heart and lungs diseases. Due to ozone layer depletion, the amount of UV radiation to earth surface causes increase in temperature, heat, stress that leads to cataract, sun burn, skin cancer, etc.

**Vector–borne disease**

Vector diseases are transmitted by ticks and mosquitos’ fleas. They spread diseases from animals to human and carry infections pathogens such as bacteria, virus and protozoa (Crimiminis et al., 2016). Lyme diseases shows symptoms such as fever, fatigue, headaches and skin rash are caused by vectors. Extreme weather events also influence how mosquitoes thrive. In certain climate conditions and spread disease. Like West Nile virus, dengue infection in some parts of the world. Rise in temperature also aid ticks to become active earlier in the season.

**Food–borne diseases**

Extreme weather events such as drought, flooding, wildfires contaminate crops and aquatic bodies with metals, chemicals and toxic substance are released into the environment. Increased temperature and heavy flooding also results in many vibrio bacteria diseases which can cause seafood infections such as cholera (National institute of Environmental Health Science, 2017).

**Infrastructure**

Sea level increase may cause heavy downpours and storms damage to coastal infrastructures such as buildings, water treatment plant, chemical storage, etc. Extreme heat is causing severe damage on transportation infrastructure such as roads, rail lines and airport runways. Also, some means of productivity are climate-specified such as food production (National Institute for Medical Research), sanitations and health infrastructures, water resources and management, housing management, etc. When there is much pressure or change in any of these infrastructures, there will definitely be disease outbreak. Intense weather event can result to collapse of buildings, reduce access to food,
inadequate or poor water supply, physical injuries, loss of life and limited access to human resources (Shongwe, 2009). Climate change affect socio-economic activities by decrease in community productivity for some primary producers, loss of income, flooding, fall in property value can lead to reduction of goods and services, stress and loss of properties and infrastructure.

Mental health

Change in global climate has made many people to neglect their area of settlement and move to new or strange communities. This kind of displacement to start new livelihood can lead people to social and mental disorder. It may also retard socio-economic status and other health hazards (Mboera et al., 2011). The effect of global climate change on mental health and well being are likely to last longer than other impacts. A lot of people's lives have been disrupted by hurricanes, wildfire, cyclones, flooding and properties are being damaged. This brings adverse health impact on human such as stress, insomnia, depression, anxiety and suicide.

CONCLUSION

The paper has extensively reviewed health implications of climate change and threats imposed on human health and its environment. Assessment of adaptation strategies suggested that action needs to be adopted to reduce the health-risk factor on public health. The evidence of increase in climate change contributes to the task of making public awareness by policy makers, government bodies to curb negative effects on the communities and reduce human vulnerabilities to prevalent and infectious diseases. More information are needed on mechanism pathway by which these pathogenic disease infect human health.

Climate change as a complex but gradual occurrence is at the peak of influencing every facets of human life thereby contributing to unhealthy environment and ill-health to populations worldwide. From human daily activities, pressures are exerted on natural and socio-economic services that support public health. Emission of greenhouse gases caused by natural induced effect and human activities/ industrial revolution has exacerbated negative implication by threatening natural resources and inflicting the public with pathogenic diseases. Government, stakeholders and private sectors need to raise awareness on strategies to counteract climate change impact and ways to improve human adaptive capacity.

Implementation of adaptation measures can have substantial benefits for health and strengthens human wellbeing.

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