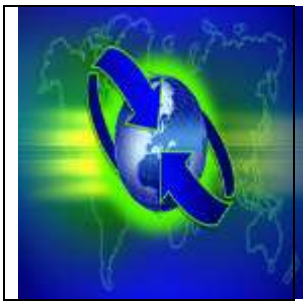

Assessing the influence of Climate Change on Human Health and Environment

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Abstract

The advent of climate change has been brought about due to the change in weather factors (precipitation, temperature, humidity, wind, etc) over an extended period of time. The change in climate has been evidential based on its consequences such as extreme weather events, increasing temperatures, increasing violent nature of natural disasters and phenomena such as desertification. The change in climate has impacted negatively on human health and the environment. The paper adopted literature review approach, where the works of researchers in related topics were reviewed by the researchers and a position taken based on the extent to which climate change affects human health and the environment. This paper delved into the concept of climate change, its causes, the relationship between climate change, human health and environmental degradation, challenges in addressing the adverse effect of climate change on human health and environmental degradation and, lastly, adaptation/mitigation strategies for ameliorating the effect of climate change on each of human health and the environment. It was discovered from the study that climate change is a global challenge with significant adverse health effects, including the spread of vector-borne diseases, heat stress, respiratory illnesses, and mental health issues. Climate change also affects the environment in terms of species diversity loss, habitat decimation and the loss of protected species and habitats. It exacerbates existing health inequities, disproportionately affecting vulnerable populations. It was recommended among others that climate change awareness campaigns should be carried out by government, NGOs, stakeholders, corporate and individuals on the causes, effects and some mitigation strategies in the communities.

Key words: Climate change, human health, environment, species loss, habitat decimation and global warming

Introduction

Climate change is one of the most pressing global challenges of the 21st century, with far-reaching impacts on human health and the environment. It refers to long-term changes in temperature, precipitation, and other atmospheric conditions primarily driven by human activities such as deforestation, industrialization, and the burning of fossil fuels. These activities release

significant amounts of greenhouse gases (GHGs) into the atmosphere, leading to global warming and disruptions in climatic patterns (Intergovernmental Panel on Climate Change [IPCC], 2021). The consequences of climate change are evident in melting of ice at the polar region, rising sea levels, flooding, excess or shortage of rainfall, increase temperature, salt water intrusion/ salinization of fresh water, extreme weather events, desertification, and biodiversity loss among others which collectively affect both the natural environment and public health (Adeomi, Fatusi, & Klipstein-Grobusch, 2022).

Adeoye, Afolahanmi, Ofili, Chirdan, Agbo, Adeoye and Su, (2022) found that in Nigeria, the effects of climate change are particularly pronounced due to its geographical location, high population density, and reliance on climate-sensitive sectors like agriculture and fisheries. The country has experienced a notable increase in average temperatures, irregular rainfall patterns, and a rise in extreme weather events such as floods and droughts. According to Ebele and Emodi (2020), climate change has exacerbated food insecurity in Nigeria, as unpredictable weather conditions disrupt farming activities and reduce crop yields. Additionally, the health sector is under significant strain, with increasing cases of climate-related diseases such as malaria, cholera, and other heat-related illnesses, (Thompson, Hornigold, Page & Waite, 2018).

Kassy, Ndu, Okeke and Aniwada, (2021) observed that Nigeria high inflation rates, increasing consumer price index, insurgency, and displacement of households have negatively affected household income expenditures on food, resulting in food insecurity with a concomitant influence on human health and the environment. This study aimed at determining the food security status and human health, as well as factors affecting these among households in Enugu state, Nigeria. The authors used a descriptive cross-sectional study of 800 households in Enugu state, Nigeria. The simple percentage analysis of data generated from the field shows that as many as 61.1% of households in Enugu State were found to be food-insecure, thereby affecting their health status. Factors such as wealth index, belonging to a cooperative society, lack of money to buy food items, and the number of accessible marketplaces affected food security.

Various coping strategies included skipping meals (77%), reducing quantity of meals (92.6%), purchasing less preferred meals (72.3%) and borrowing food and money (31.3%) were recommended. It was observed that the prevalence of food-insecure households was high, mostly due to poverty, not belonging to a cooperative society, and few accessible marketplaces. The authors concluded that there a very high rate of food insecurity with commensurate effects on human health, so therefore there is the need for economic and political stability that is supportive of households. There should be reduction in the quantity of food consumed, there was also the recommendations that household should lean to skip meals.

Authors like Kjellstrom, Briggs, Freyberg, Lemke, Otto, Hyatt, (2016) who studied heat, human performance, and occupational health: a key issue for the assessment of global climate change impacts, found that during climate change events, humans are exposed to different kinds of heat waves and fluxes, especially in areas where there is serious urban heat islands. These events have serially affected human dehydrations, environmental stress and other negative impacts on the environment and human health. Other authors supported this position (McMichael, Dasgupta, Ayeb-Karlsson & Kelman, 2020; Schwerdtle, McMichael, Mank, Sauerborn, Danquah & Bowen 2020; Liu, Trtanj, Lipp & Balbus, 2021).

Giorgini, Di Giosia, Petrarca, Lattanzio, Stamerra, and Ferri, (2017), researched the relationship between climate change and human health: a review of the effect of environmental stressors on cardiovascular diseases across epidemiology and biological mechanisms. The authors observed that there is a rapid effect of climate change on the planet. These authors posited that the most relevant example is global warming, which impacts on the earth's ecosystems, threatening human health. Other effects include extreme variations in temperature and increases in air pollution. These events may negatively impact mortality and morbidity for cardiovascular diseases. The paper looked at the main effects of climate changes on cardiovascular diseases, reporting the epidemiological evidences and the biological mechanisms linking climate change consequences to hypertension, diabetes, ischemic heart diseases, heart failure and stroke.

These authors' findings suggest that humans operate under different weather conditions, even though extreme temperatures and higher levels of air pollution can influence health-related outcomes.

In these cases, climate change adversely affects cardiovascular system and the high-risk subjects for cardiovascular diseases are those more exposed. The authors therefore concluded that climate change implications on public health and suggest adaptation strategies to monitor the high-risk population, and reduce the amount of hospital admissions associated with these events. Such interventions may minimize the costs of public health and reduce the mortality for cardiovascular diseases. The position of this paper had been also discussed in the works of Ray, West, Clark, Gerber, Prishchepov and Chatterjee, (2019) whose work found that climate change has taken serious toll on food production and availability, shortage of food affects human health through the exposure of humans to food insecurity leading to nutrition deficient food consumption. When humans have poor feeding habits due to lack or shortage of food, human immune systems are compromised exposing the person or people to different opportunistic infections, (Sarkar, Gangare, Singh & Dhiman, 2019).

In another research on the effects of climate change on human behaviors, Celik, (2020), the author observed that urbanization movements have accelerated the migration of people from rural areas to urban centers, and they lead people to different productions and behaviors as a result of increasing population density and changing living standards all around the world. The environment is largely polluted by increasing urbanization, industrialization, and greenhouse gases emitted from residential areas. This causes the atmosphere to become increasingly polluted. These adversities cause environmental problems that threaten life in water, land, and air by destroying nature and changing the climate of cities. In recent years, numerous floods and earthquakes have occurred in many haphazard settlements (Nerbass, Pecoits-Filho, Clark, Sontrop, McIntyre & Moist, 2017; Di-Napoli, Pappenberger & Cloke 2018; Borchers, Bowman, Palmer & Johnston, 2020).

As a result of these disasters, many people lose their lives, get injured and become homeless. After such cases, people migrate to different settlements, their perspective change after natural disasters, and they move towards different professions and purposes. The effects of climate change on agriculture could not be ignored. Changes in precipitation and temperature as well as the increase in CO_2 levels leading to climate change have significant impacts on global agriculture. The decrease in the yield of agricultural products and the change in land structure cause people not to receive recompense for their labor and break their hopes. This leads people to different goals and occupations. In conclusion, climate change affects all areas such as health, social mobility, agriculture, economy, industry, and tourism negatively and constitutes significant changes in people's lifestyles, both material and spiritual.

The adverse health effects of climate change are both direct and indirect. Direct impacts include heat stress, injuries, and fatalities resulting from extreme weather events like hurricanes and floods. Indirectly, climate change affects health by altering ecosystems, increasing the prevalence of vector-borne diseases, and compromising access to clean water and food (Okonkwo, Anozie & Udeh, 2021). For example, stagnant floodwaters in many parts of Nigeria serve as breeding grounds for mosquitoes, leading to higher transmission rates of malaria. Similarly, rising temperatures and changing precipitation patterns have been linked to outbreaks of cholera in coastal areas such as Lagos and the Niger Delta region (Kassy, et al, 2021; Adejuwon, 2022).

Giorgini, et al., (2017) and Celik, (2020) found that The environmental consequences of climate change further compound its health impacts. Deforestation, desertification, and land degradation have led to the loss of biodiversity and natural resources, which are essential for human survival. Rising sea levels threaten coastal communities, displacing millions and exposing them to health risks such as malnutrition, waterborne diseases, and mental health issues. The National Environmental Standards and Regulations Enforcement Agency (NESREA) highlights that Nigeria's efforts to combat the climate change consequences is hindered by limited resources, weak enforcement of environmental policies, and insufficient public awareness (NESREA, 2021).

Brajesh, Manuel, Eleonora, Emilio, Jan, Leach, Hongwei and Pankaj, (2023) found that addressing the health effects of climate change requires a multidimensional approach that includes mitigation and adaptation strategies. These strategies must involve reducing greenhouse gas emissions, strengthening public health systems, and promoting community resilience. Furthermore, the role of education and awareness cannot be overemphasized in building a sustainable future. Public campaigns and environmental education programs in schools can empower individuals to adopt sustainable practices and advocate for climate action.

Concept of Climate Change

Celik, (2020) saw climate change refers to the long-term alterations in temperature, precipitation, wind patterns, and other elements of the Earth's climate system. While Earth's climate has naturally fluctuated over millions of years, the current rate of change is unprecedented and it is primarily driven by human activities and natural events. These activities, including the burning of fossil fuels, deforestation, industrial emissions, and large-scale agriculture, have significantly increased the concentration of greenhouse gases (GHGs) such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) in the atmosphere (Akinbami, Lawal & Odetokun, 2019).

Kassy, Ndu, Okeke and Aniwada, (2021) found that greenhouse gases trap heat within the Earth's atmosphere through a process known as the greenhouse effect, which maintains the planet's

temperature at levels conducive to life. However, excessive GHG emissions have intensified this effects, leading to global warming. According to Nwankwo, Akpan and Umeojiaku (2020) this has resulted in a rise in global temperatures, melting of polar ice caps, rising sea levels, and disruptions to weather patterns, among other phenomena. In Nigeria, for example, climate change manifests in the form of erratic rainfall, prolonged dry seasons, and severe flooding, all of which have far-reaching implications for agriculture, environment, human health, and infrastructure.

Borchers, Bowman, Palmer and Johnston, (2020) posited that human-induced climate change is closely tied to industrialization and urbanization. Since the industrial revolution, economic activities have increasingly relied on fossil fuels, leading to a steady increase in CO_2 emissions. In addition, deforestation, often driven by agricultural expansion and logging—reduces the planet's capacity to absorb CO_2. Adegoke and Olagunju (2021) emphasize that in Nigeria, the deforestation rate is alarmingly high, with forests being cleared for farming and urban development, further contributing to GHG accumulation.

Adeoye, Afolahanmi, Ofili, Chirdan, Agbo, Adeoye and Su, (2022) observed that climate change is not solely about rising temperatures. It also encompasses changes in precipitation patterns, increased frequency and intensity of extreme weather events, and shifts in ecosystems. These changes have profound consequences for the natural environment and human societies. For instance, extreme weather events such as hurricanes, droughts, and floods disrupt ecosystems and result in loss of lives, property, and biodiversity. Similarly, shifting climate zones affect agricultural productivity and the distribution of species, including pests and diseases (Álvaro et al., 2017; Di Napoli, et al., 2018; Brajesh, et al. 2023).

The concept of climate change also extends to the feedback mechanisms that amplify its effects. For example, the melting of polar ice reduces the Earth's albedo (reflectivity), causing more heat to be absorbed by the planet's surface. This, in turn, accelerates warming and leads to further ice loss, creating a vicious cycle. Climate scientists, therefore, emphasize the need for immediate and sustained action to mitigate GHG emissions and adapt to the changing climate.

Brajesh, Manuel, Eleonora, Emilio, Jan, Hongwei, and Pankaj, (2023) researched on climate change impacts on plant pathogens, food security and paths forward, the authors observed that plant disease outbreaks pose significant risks to global food security and environmental sustainability worldwide, and results in the loss of primary productivity and biodiversity that negatively impact the environmental and socio-economic conditions of affected regions. Climate change further increases outbreak risks by altering pathogen evolution and host–pathogen interactions and facilitating the emergence of new pathogenic strains. Pathogen range can shift, increasing the spread of plant diseases in new areas.

Brajesh, et al., (2023) examined how plant disease pressures are likely to change under future climate scenarios and how these changes will relate to plant productivity in natural and agricultural ecosystems. The authors further explored current and future impacts of climate change on pathogen biogeography, disease incidence and severity, and their effects on natural ecosystems, agriculture and food production. The researchers proposed that amendment of the current conceptual framework and incorporation of eco-evolutionary theories into research could improve our mechanistic understanding and prediction of pathogen spread in future climates, to mitigate the future risk of disease outbreaks. The work however highlighted the need for a science–policy interface that works closely with relevant intergovernmental organizations to provide effective monitoring and management of plant disease under future climate scenarios, to ensure long-term food and nutrient security and sustainability of natural ecosystems.

Álvaro, Rubén, Rosa, Martín-Aranda, Maria, (2017) researched on environmental impacts of climate change adaptation, in this study, the authors observed that climate change adaptation reduces adverse effects of climate change but may also have undesirable environmental impacts. However, these impacts are yet poorly defined and analyzed in the existing literature. To complement this knowledge-gap, the authors reviewed the literature to unveil the relationship between climate change adaptation and environmental impact assessment, and the degree to which environmental impacts are included in climate change adaptation theory and practice. The

literature reviewed revealed that technical, social and economic perspectives on climate change adaptation receive much more attention than the environmental perspective.

These authors found that the scarce interest on the environmental impacts of adaptation may be attributed to:

a. an excessive sectorial approach, with dominance of non-environmental perspectives,

b. greater interest in mitigation and direct climate change impacts rather than in adaptation impacts,

c. a tendency to consider adaptation as inherently good, and

d. subjective/preconceived notions on which measures are good or bad, without a comprehensive assessment.

Different authors and different research works like those of Cunsolo and Ellis (2018).;Becsi, Hohenwallner-Ries, Grothmann, Prutsc, Huber and For- mayer, (2019); Sarkar, Gangare, Singh and Dhiman, (2019) differently posited that environmental assessment (EA) has a long established history as an effective tool to include environment into decision-making, although it does not yet guarantee a proper assessment of adaptation, because it is still possible to postpone or even circumvent the processes of assessing the impacts of climate adaptation. These authors suggested that there is a need to address adaptation proactively by including it in EA, to update current policy frameworks, and to demand robust and reliable evaluation of alternatives. Only through the full EA of adaptation measures can we improve our understanding of the primary and secondary impacts of adaptation to global environmental change.

Causes of Climate Change

Climate change refers to long-term changes in global temperatures and weather patterns, primarily driven by natural and human-induced factors. In Nigeria, the rapid pace of climate change is attributed to various anthropogenic activities, including greenhouse gas emissions, deforestation, and industrialization reliance on fossil fuels.

Greenhouse Gas Emissions

Greenhouse gases (GHGs) such as carbon dioxide (CO_2), methane (CH_4), particulate matter and nitrous oxide (N_2O) trap heat in the atmosphere, intensifying the greenhouse effect and contributing to global warming. In Nigeria, significant sources of GHG emissions include gas flaring from oil and gas production, vehicular emissions, and the use of biomass for cooking. Also methane from paddy rice field and waste dump including that from slash and burn or bush burning all contribute to greenhouse gas emissions resulting to global warming (Agbola & Fayiga, 2016; Nerbass, et al., 2017; Ray, et al., (2019; Borchers et al., 2020). Gas flaring alone contributes substantially to the country's CO_2 emissions, making it one of the largest emitters in Africa (Elum & Momodu, 2017). Similarly, methane emissions from agriculture, (deforestation, bush burning and from paddy rice field) and solid waste management exacerbate the problem.

Deforestation and Land Use Changes

Deforestation, primarily driven by agricultural expansion, urbanization, and logging, is another major causes of climate change in Nigeria (Nerbass, et al., 2017; Ray, et al., (2019; Borchers et al., 2020). The removal of forests reduces the planet's ability to absorb CO_2 during photoshynthesis, thus increasing atmospheric carbon levels. Additionally, land use changes often lead to soil erosion, biodiversity loss, and desertification, which are prevalent in Nigeria's northern regions (Department of Climate Change, 2021). The increasing demand for fuel wood by rural communities further accelerates deforestation, contributing to environmental degradation (Agbola & Fayiga, 2016; Sarkar, et al., 2019; Becsi, et al., 2019).

Industrialization and Fossil Fuels

The industrial sector in Nigeria heavily relies on fossil fuels such as oil, natural gas, and coal for energy production, releasing substantial amounts of GHGs into the atmosphere (Ritchie & Roser, 2020). Industrial processes such as cement manufacturing and chemical production also contribute to CO_2 emissions. Moreover, Nigeria's dependence on petroleum products for electricity generation and transportation exacerbates its carbon footprint (Elum & Momodu,

2017). Despite efforts to transition towards renewable energy, the dominance of fossil fuels remains a significant challenge.

Climate Change and Human Health

Climate change poses significant health risks to populations worldwide, with its adverse effects being direct, indirect, and far-reaching. Rising global temperatures, extreme weather events, and altered environmental conditions directly threaten human health, while their indirect effects disrupt ecosystems, livelihoods, and health systems, leading to various health crises.

Direct Effect: Sarkar, et al., (2019); Becsi, et al., (2019); and Eneji, et al., (2022) discussed the following as direct impacts of global climate change, they include:

i. One of the most immediate health impacts of climate change is heat-related illnesses. Prolonged heatwaves increase the incidence of heat exhaustion, heatstroke, and dehydration, particularly among vulnerable groups such as children, the elderly, and individuals with pre-existing health conditions. In regions where temperatures are already high, such as tropical and subtropical areas, the risks of heat-related mortality are significantly heightened.

ii. Extreme weather events such as hurricanes, floods, and droughts also pose direct health threats. Flooding, for instance, can lead to injuries, drowning, and displacement of communities. It also creates breeding grounds for waterborne diseases such as cholera and typhoid fever. Droughts, on the other hand, exacerbate food and water shortages, leading to malnutrition, dehydration, and increased vulnerability to diseases.

iii. Climate change also influences the distribution and prevalence of vector-borne diseases. Warmer temperatures and altered rainfall patterns expand the habitats of vectors such as mosquitoes and ticks, leading to increased transmission of diseases like malaria, dengue fever, and Lyme disease. Regions previously unaffected by these diseases may become new hotspots, placing additional burdens on healthcare systems.

iv. Air pollution, closely linked to climate change, contributes to respiratory and cardiovascular illnesses. Rising levels of pollutants such as ozone and particulate matter exacerbate conditions like asthma, bronchitis, and chronic obstructive pulmonary disease. Additionally, wildfires fueled by prolonged droughts release harmful smoke and pollutants into the air, affecting both respiratory and cardiovascular health.

Indirect Effect: Eneji, et. Al, (2021); Kassy, Ndu, Okeke and Aniwada, (2021) presented the following as the indirect consequences of climate change:

The Indirect effects of climate change on mental health are equally significant.

- Communities affected by extreme weather events often experience trauma, anxiety, and depression due to displacement, loss of property, and uncertainty about the future. Prolonged exposure to adverse conditions, such as droughts or rising sea levels, can lead to chronic stress and other mental health issues.
- Climate change disrupts agricultural productivity, leading to food insecurity and malnutrition. Changes in rainfall patterns, increased frequency of extreme weather events, and rising temperatures affect crop yields and livestock production. Food shortages not only result in hunger but also weaken immune systems, making individuals more susceptible to infectious diseases (Eneji, et. al, 2021; Kassy, et al., 2021).

Climate Change and Environmental Degradation

Kjellstrom, et al., (2016) and McMichael, et al., (2020) found that climate change has profound and widespread effects on the environment, disrupting natural systems and altering the delicate balance that supports life on Earth. These effects are evident in rising global temperatures, shifting weather patterns, and changes to ecosystems. The environmental consequences of climate change not only affect biodiversity but also create cascading impacts that influence human livelihoods and development.

i. One of the most visible effects of climate change is the rise in global temperatures, commonly referred to as global warming. This phenomenon has led to the melting of

polar ice caps and glaciers, contributing to rising sea levels. Coastal areas, especially low-lying regions, face significant risks from flooding, erosion, and saltwater intrusion into freshwater systems. These changes threaten ecosystems, displace populations, and jeopardize agricultural productivity (Adejuwon, 2019).

ii. Shifts in weather patterns due to climate change are another critical environmental impact. Extreme weather events, such as hurricanes, droughts, and floods, are becoming more frequent and severe. Droughts result in water shortages and desertification, while heavy rainfall and flooding damage infrastructure, degrade soil quality, and disrupt agricultural activities. Such changes undermine the stability of ecosystems and diminish their capacity to provide essential services.

iii. Climate change also alters ecosystems and biodiversity. Species that cannot adapt to rapidly changing environmental conditions face the risk of extinction. Warmer temperatures, changing precipitation patterns, and shifting climate zones force many species to migrate, often resulting in disruptions to ecological balance. For instance, marine ecosystems are affected by ocean warming and acidification, which threaten coral reefs and the diverse species that depend on them (Nwankwo & Uche, 2021).

iv. In addition to these effects, climate change exacerbates land degradation and deforestation. Increasing temperatures and erratic rainfall patterns reduce vegetation cover, making soils more prone to erosion. The loss of forested areas, whether through natural processes or human activities, further accelerates climate change by reducing the planet's capacity to absorb carbon dioxide.

Vulnerable Populations to Climate-Related Health Risks

Cunsolo and Ellis, (2018); Thompson, et al., (2018) in their respective studies found that certain groups are disproportionately affected by the health impacts of climate change due to their socioeconomic status, geographic location, age, or pre-existing conditions. These vulnerable populations include:

Children: Children are highly susceptible to climate-related health risks such as heat-related illnesses, malnutrition, and respiratory conditions. Their developing immune systems and higher metabolic rates make them more vulnerable to the effects of air pollution, vector-borne diseases, and food insecurity (Akinbami *et al*., 2019).

Elderly Individuals: Older adults face higher risks from extreme heat events, as they may have pre-existing health conditions that make it harder for their bodies to regulate temperature. Additionally, they are more likely to suffer from heat stress, dehydration, and cardiovascular diseases exacerbated by climate change (Nwankwo *et al*., 2020).

Pregnant Women: Pregnant women are particularly vulnerable to the effects of climate change, including heat stress, poor air quality, and food insecurity. These factors can result in adverse pregnancy outcomes, such as preterm births and low birth weights.

Low-Income Communities: Individuals in low-income communities often lack access to resources such as healthcare, clean water, and nutritious food, making them more vulnerable to climate-related health risks. They are also more likely to live in areas prone to flooding, droughts, or other extreme weather events.

Indigenous Populations: Indigenous communities that rely on natural resources for their livelihoods are disproportionately affected by climate change. Changes in ecosystems and biodiversity disrupt their traditional practices, impacting their health and cultural heritage.

People with Pre-Existing Health Conditions: Individuals with chronic illnesses such as asthma, cardiovascular diseases, or compromised immune systems are more vulnerable to the impacts of air pollution, heat-waves, and other climate-related health risks.

Displaced Populations: Climate-related events such as floods, droughts, and hurricanes often force people to migrate or live in temporary shelters, where they face heightened risks of malnutrition, waterborne diseases, and mental health challenges.

Challenges in addressing the adverse effect of Climate Change on human health and the environment

Human Health

Adeoye, et al, (2022) posited that addressing the complex relationship between climate change and health poses significant challenges across various domains. Below are some of the key challenges:

- Many individuals and communities lack understanding of how climate change impacts health, such as the spread of vector-borne diseases, heat-related illnesses, and respiratory conditions.
- Healthcare systems in many regions, particularly in developing countries, are ill-equipped to handle the increasing health burden caused by climate change.
- A significant challenge lies in the limited availability of data on the health impacts of climate change. Insufficient research hampers efforts to predict future trends, design effective interventions, and tailor policies to address specific health concerns.
- Marginalized communities, including the poor, elderly, children, and those with pre-existing health conditions, face disproportionate health risks from climate change.
- Political inaction, conflicting priorities, and lack of international cooperation often stall progress in addressing climate change and its health effects.
- Climate change exacerbates the spread of infectious diseases like malaria, dengue, and cholera, while also increasing the prevalence of non-communicable diseases due to heat stress, air pollution, and changing dietary patterns. Managing this dual burden strains existing healthcare resources (Schwerdtle, et al., 2020; Liu, et al., 2021).

Environment

Salau, Olalere and Affolabi, (2022) and Omachi, Van Onselen and Kolanisi, (2022) observed that climate change impacts on the environment can be seen from a multiplicity of dimensions, some of the effects include:

1. Lack of adequate funding and resources to implement effective mitigation and adaptation strategies, particularly in developing countries like Nigeria. This financial constraint

limits the ability to invest in renewable energy, sustainable agriculture, and infrastructure resilience.

2. Low level of public awareness and education about climate change. Many communities, especially in rural areas, lack sufficient knowledge about the causes, impacts, and potential solutions, which hinders grassroots support for environmental initiatives.
3. Weak institutional capacity and governance. Poor coordination among government agencies, limited enforcement of environmental policies, and corruption undermine efforts to address climate change effectively.
4. Rapid urbanization and population growth exacerbate environmental degradation. The increasing demand for land, water, and energy often leads to deforestation, pollution, and unsustainable resource exploitation, further aggravating climate-related challenges.
5. There is the issue of technological limitations. Developing nations face challenges in accessing and deploying advanced technologies required for climate monitoring, renewable energy production, and disaster management, which are essential for combating the adverse effects of climate change.

Adaptation and Mitigation Strategies for Reducing Health and environmental Impacts

Ayeni, Adewumi, (2023); Bwala, Otekunrin, Adebowale, Fasina, Odetokun and Fasina, (2023) held that adapting and mitigating the health impacts of climate change requires targeted strategies to minimize risks, enhance resilience, and ensure public well-being. According to authors like Orjiakor, Adediran, Ugwu and Nwachukwu, (2023), some key strategies or approaches to mitigating these effects include:

- **Strengthening Healthcare Systems**: Build climate-resilient healthcare facilities that can withstand extreme weather events. Equip hospitals and clinics with the necessary resources to address climate-related health emergencies effectively.

- **Developing Early Warning Systems**: Establish monitoring systems to predict and respond to heatwaves, floods, and disease outbreaks. Timely alerts can help vulnerable populations prepare and reduce exposure to risks.
- **Enhancing Public Awareness:** Educate communities about climate-related health risks and promote preventive measures. Public health campaigns can focus on topics like heatwave preparedness, disease prevention, flooding and sustainable living practices.
- **Improving Urban Planning**: Incorporate green spaces, better drainage systems, and energy-efficient designs in urban development to reduce heat island effects, improve air quality, and minimize flood risks.
- **Promoting Renewable Energy:** Transition to clean and renewable energy sources such as solar, wind, and hydroelectric power to reduce air pollution and associated respiratory health issues.
- **Strengthening Food Security**: Support climate-smart agriculture to ensure a stable food supply during periods of drought or extreme weather. Diversify crops and improve food storage techniques to reduce malnutrition risks.
- **Expanding Access to Clean Water:** Develop sustainable water management systems to ensure access to clean water, especially in areas prone to droughts or flooding, reducing the prevalence of waterborne diseases.
- **Improving Vector Control Measures**: Strengthen programs to monitor and control the spread of vector-borne diseases. This includes eliminating mosquito breeding sites and promoting the use of protective measures like insecticide-treated nets.
- **Building Community Resilience**: Empower local communities to take part in climate adaptation strategies by providing training, resources, and opportunities to contribute to environmental protection and disaster preparedness.

- **Encouraging Reforestation and Afforestation:** Promote large-scale tree planting programs to mitigate air pollution, reduce carbon dioxide levels, and create buffer zones against natural disasters like floods and landslide.
- **Integrating Climate Policies into Public Health Planning:** Ensure that public health strategies account for climate risks by integrating climate adaptation measures into national and local health policies, (Yahaya, Sanusi, Eyinla & Samuel, 2021; Adebisi, Adebisi & Odum, 2022; Oyeniran & Olajide, 2023).

Conclusion

Climate change is a global challenge with significant adverse health effects, including the spread of vector-borne diseases, heat stress, respiratory illnesses, and mental health issues. It exacerbates existing health inequities, disproportionately affecting vulnerable populations. Addressing these impacts requires robust healthcare systems, public awareness, and sustainable practices. Education, especially from chemistry teachers, is crucial in equipping future generations with knowledge and innovative solutions. Political commitment, global collaboration, and long-term planning are essential to mitigate health risks and build resilience. Promoting green energy, reducing emissions, and adopting sustainable lifestyles are key actions to having a clean environment. Strengthened policies and targeted interventions can protect communities and foster equity. Ultimately, combating climate change is a shared responsibility to ensure a healthier, sustainable future for all.

Recommendations for policy directions

a) Government and all stakeholders including NGOs and corporate and private individuals should organize awareness campaigns on the causes, effects and mitigation of climate change.

b) Health education should also be introduced in the communities to help guide them about the health effects of climate change and the mitigation strategies

c) Farmers and hunters of wildlife should be educated on sustainable exploitation of natural resources including green agriculture with indigenous crop varieties and not genetically modified organisms (GMOs)

d) There should be less dependence on artificial or inorganic manure, rather lets encourage green manure or farm yard manure (organic manure)

e) Tree planting, mulching and hedgerow should be planted in our households.

f) Climate friendly practices should be encouraged in our communities.

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