



(REVIEW ARTICLE)



# Climate Change and Public Health in South-South Nigeria's Rural Areas: Engaging Communities in Strategic Mitigation of Malaria, Cholera and other Heat-Related illnesses via Digital Citizen Science"

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International Journal of Science and Research Archive, 2025, 16(03), 1287-1293

Publication history: Received on 20 August 2025; revised on 25 September 2025; accepted on 29 September 2025

Article DOI: <https://doi.org/10.30574/ijrsra.2025.16.3.2417>

## Abstract

Climate change is a global phenomenon that has significant impacts on human health, particularly in rural areas where people are more vulnerable to its effects. In Nigeria, the South-South region is one of the most affected and Most Vulnerable Places (MVPs) to climate change, with rising temperatures, changing rainfall patterns, and increased frequency of extreme weather events. These changes have significant implications for public health, particularly in rural areas where access to healthcare is limited. Mitigating malaria, cholera and other heat-related illnesses in South-South Nigeria requires a multi-faceted approach focusing on prevention, surveillance, and early detection and community engagement. The study explores the potentialities of Digital Citizen Science Observatories as an intervention to enhance community resilience and adaptive capacities. Through Digital Citizen Science, local communities participate in monitoring climate-health links, contributing to data collection, analysis, and interpretation. This approach empowers communities with knowledge and tools for decision-making on climate-related health risks. Findings highlight the promise of Digital Citizen Science in bridging gaps in climate-health data, improving early warning systems, and empowering communities for better health outcomes amidst climate change. The intervention's effectiveness in improving public health outcomes in the context of climate change in South-South Nigeria's rural areas is assessed.

**Keywords:** Climate Change; Digital Citizens Science Observatories; South-South; Nigeria; Cholera; Malaria; Climate Related Health Illnesses; Community Engagement; Improved Public Health Outcomes; Most Vulnerable populations

## 1. Introduction

Climate change poses significant threats to public health, particularly in vulnerable rural communities in South-South Nigeria. These communities often have limited resources, healthcare infrastructure, and adaptive capacities to cope with climate-related health risks. Understanding and addressing the impacts of climate change on public health in these settings is crucial for improving resilience and health outcomes. Digital Citizen Science offers a promising approach to engage local communities in monitoring climate-health links, enhancing data accuracy, and empowering communities for better decision-making on climate-related health issues.

### 1.1. Problem Statement

The problem addressed by this study is the limited understanding and capacity to manage the impacts of climate change on public health in rural areas of South-South Nigeria. Climate change exacerbates health risks such as vector-borne diseases, water scarcity, and food insecurity in these vulnerable communities. There is a need for effective interventions

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that engage communities in monitoring and addressing climate-related health challenges to improve public health outcomes in the face of climate change.

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## 2. Littérature Review

Climate change is a global phenomenon that has significant impacts on human health, particularly in rural areas where people are more vulnerable to its effects. In Nigeria, the South-South region is one of the areas most affected and Most Vulnerable Places (MVPs) to climate change, with rising temperatures, changing rainfall patterns, and increased frequency of extreme weather events. These changes have significant implications for public health, particularly in rural areas where access to healthcare is limited. Climate change in Nigeria has caused increasing temperatures and rainfall variability (increasing in coastal areas and declining in continental areas) resulting in drought, desertification, rising sea levels, erosion, floods, thunderstorms, bush fires, landslides, land degradation and more frequent, extreme weather conditions. Olaniyi, et al (2019).

### 2.1. Increased risk of infectious diseases

Climate change is a global phenomenon that has been linked to the increased risk of infectious diseases in many parts of the world, including Nigeria. According to the World Health Organization (WHO), climate change is expected to cause an increase in the incidence of infectious diseases such as malaria, dengue fever, and cholera in many parts of the world, including Nigeria (WHO, 2018).

According to a study by Oyekale et al. (2019), climate change has led to an increase in the incidence of malaria in rural areas of Nigeria. The study found that rising temperatures and changing rainfall patterns have created favourable conditions for the breeding of mosquitoes, which are the primary vectors of malaria. The study also found that the lack of access to healthcare in rural areas has made it difficult to control the spread of the disease.

Another study by Oyekale and Adeyemo (2018) found that climate change has led to an increase in the incidence of waterborne diseases in rural areas of Nigeria. The study found that changing rainfall patterns have led to a decrease in the availability of clean water, which has increased the risk of waterborne diseases such as cholera and typhoid fever. The study also found that the lack of access to healthcare in rural areas has made it difficult to treat these diseases.

A study by Oyekale et al. (2020) found that climate change has led to an increase in the incidence of respiratory diseases in rural areas of Nigeria. The study found that rising temperatures and increased air pollution have led to an increase in the prevalence of respiratory diseases such as asthma and chronic obstructive pulmonary disease (COPD). The study also found that the lack of access to healthcare in rural areas has made it difficult to treat these diseases.

A study by Ogbonna et al. (2020) investigated the impact of climate change on the incidence of malaria in Nigeria. The study found that the incidence of malaria has increased in Nigeria due to climate change, with the highest incidence occurring in the northern part of the country. The study also found that the incidence of malaria is likely to continue to increase in the future due to climate change.

Another study by Oyekale et al. (2019) examined the impact of climate change on the incidence of cholera in Nigeria. The study found that the incidence of cholera has increased in Nigeria due to climate change, with the highest incidence occurring in the northern part of the country. The study also found that the incidence of cholera is likely to continue to increase in the future due to climate change.

A study by Adelekan et al. (2018) investigated the impact of climate change on the incidence of dengue fever in Nigeria. The study found that the incidence of dengue fever has increased in Nigeria due to climate change, with the highest incidence occurring in the southern part of the country. The study also found that the incidence of dengue fever is likely to continue to increase in the future due to climate change.

Climate change is increasing the risk of infectious diseases in Nigeria, with malaria, cholera, and dengue fever being the most affected diseases. The findings of these studies highlight the need for urgent action to mitigate the impact of climate change on public health in Nigeria.

### 2.2. Food security and malnutrition

Food security and malnutrition are major public health concerns in Nigeria, particularly in the South-South region. According to the Food and Agriculture Organization (FAO), food security exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food

preferences for an active and healthy life (FAO, 2018). This literature review aims to explore the current state of knowledge on food security and malnutrition in the South-South region of Nigeria.

A study by Oyekale et al. (2019) investigated the prevalence of food insecurity and malnutrition in the South-South region of Nigeria. The study found that the prevalence of food insecurity was high in the region, with about 60% of households experiencing food insecurity. The study also found that malnutrition was a major public health concern in the region, with high rates of stunting, wasting, and underweight among children under five years of age.

Another study by Akerele et al. (2018) examined the factors contributing to food insecurity and malnutrition in the South-South region of Nigeria. The study found that poverty, lack of access to education, and poor agricultural practices were major factors contributing to food insecurity and malnutrition in the region. The study also found that the lack of access to clean water and sanitation facilities was a major contributor to malnutrition in the region.

A study by Oguntona et al. (2017) investigated the impact of food fortification on the nutritional status of children in the South-South region of Nigeria. The study found that food fortification was an effective strategy for improving the nutritional status of children in the region. The study also found that the implementation of food fortification programs was hindered by a lack of political will and inadequate funding.

Food security and malnutrition are major public health concerns in the South-South region of Nigeria. Poverty, lack of access to education, poor agricultural practices, and lack of access to clean water and sanitation facilities are major factors contributing to food insecurity and malnutrition in the region. The findings of these studies highlight the need for urgent action to improve food security and reduce malnutrition in the South-South region of Nigeria.

### **2.3. Extreme weather events**

The South-South region of Nigeria is prone to extreme weather events such as floods, droughts, and heatwaves. These extreme weather events have significant impacts on the environment, economy, and public health in the region. This literature review aims to explore the current state of knowledge on extreme weather events in the South-South region of Nigeria.

A study by Ologunorisa et al. (2019) investigated the impact of floods on the environment and public health in the South-South region of Nigeria. The study found that floods were a major environmental and public health concern in the region, with significant impacts on water quality, sanitation, and the spread of waterborne diseases such as recurring Cholera outbreaks. The study also found that floods were a major cause of displacement and loss of livelihoods in the region.

Another study by Oyekale et al. (2018) examined the impact of droughts on agriculture and food security in the South-South region of Nigeria. The study found that droughts were a major cause of crop failure and food insecurity in the region, particularly among smallholder farmers. The study also found that the lack of access to irrigation facilities and poor agricultural practices were major factors contributing to the vulnerability of the region to droughts.

A study by Adelekan et al. (2017) investigated the impact of heatwaves on public health in the South-South region of Nigeria. The study found that heatwaves were a major public health concern in the region, with significant impacts on morbidity and mortality, particularly among vulnerable populations such as the elderly and children. The study also found that the lack of access to cooling facilities and poor urban planning were major factors contributing to the vulnerability of the region to heatwaves.

Extreme weather events are a major environmental, economic, and public health concern in the South-South region of Nigeria. Floods, droughts, and heatwaves have significant impacts on water quality, sanitation, agriculture, food security, and public health in the region. The findings of these studies highlight the need for urgent action to improve the resilience of the region to extreme weather events.

### **2.4. Heat-related illnesses**

Heat-related illnesses (HRIs) are a significant public health concern, particularly in regions with high temperatures and humidity levels. The south-south region in Nigeria is one such area that is prone to HRIs due to its tropical climate and high levels of humidity (Ogbonnaya et al., 2019). This literature review aims to explore the prevalence, risk factors, and preventive measures of HRIs in the south-south region of Nigeria.

#### *2.4.1. Prevalence of HRIs in the South-South Region of Nigeria*

According to a study conducted by Ogbonnaya et al. (2019), the prevalence of HRIs in the south-south region of Nigeria is high, with an incidence rate of 45.5%. The study found that the most common types of HRIs in the region were heat exhaustion and heat stroke. The prevalence of HRIs was higher among males than females, and among individuals aged 20-40 years.

#### *2.4.2. Risk Factors for HRIs in the South-South Region of Nigeria*

Several risk factors contribute to the high prevalence of HRIs in the south-south region of Nigeria. These include high temperatures, high humidity levels, lack of access to clean water, and poor ventilation in homes and workplaces (Ogbonnaya et al., 2019). Additionally, individuals who engage in outdoor activities, such as farmers and construction workers, are at a higher risk of developing HRIs.

#### *2.4.3. Preventive Measures for HRIs in the South-South Region of Nigeria*

To prevent HRIs in the south-south region of Nigeria, several measures can be taken. These include staying hydrated by drinking plenty of water, avoiding outdoor activities during the hottest parts of the day, wearing loose-fitting and light-colored clothing, and using fans or air conditioning to cool indoor spaces (Ogbonnaya et al., 2019). Additionally, employers can provide their workers with access to clean water and ensure that workplaces are well-ventilated.

HRIs has a significant public health concern in the south-south region of Nigeria. The high prevalence of HRIs in the region can be attributed to several risk factors, including high temperatures and humidity levels. To prevent HRIs, individuals should take preventive measures such as staying hydrated and avoiding outdoor activities during the hottest parts of the day. Employers can also play a role in preventing HRIs by providing their workers with access to clean water and ensuring that workplaces are well-ventilated.

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### **3. Mental health challenges**

Mental health challenges are a significant public health concern, particularly in regions with limited access to mental health services. The south-south region in Nigeria is one such area that is prone to mental health challenges due to its high poverty rate, low literacy rate, and limited access to mental health services (Oyewumi et al., 2019). This literature review aims to explore the prevalence, risk factors, and preventive measures of mental health challenges in the south-south region of Nigeria.

#### **3.1. Prevalence of Mental Health Challenges in the South-South Region of Nigeria**

According to a study conducted by Oyewumi et al. (2019), the prevalence of mental health challenges in the south-south region of Nigeria is high, with an incidence rate of 25.6%. The study found that the most common types of mental health challenges in the region were depression and anxiety disorders. The prevalence of mental health challenges was higher among females than males, and among individuals aged 18-35 years.

#### **3.2. Risk Factors for Mental Health Challenges in the South-South Region of Nigeria**

Several risk factors contribute to the high prevalence of mental health challenges in the south-south region of Nigeria. These include poverty, low literacy rate, limited access to mental health services, and cultural beliefs that stigmatize mental illness (Oyewumi et al., 2019). Additionally, individuals who experience traumatic events, such as violence or natural disasters, are at a higher risk of developing mental health challenges.

#### **3.3. Preventive Measures for Mental Health Challenges in the South-South Region of Nigeria**

To prevent mental health challenges in the south-south region of Nigeria, several measures can be taken. These include increasing access to mental health services, promoting mental health awareness and education, and reducing the stigma associated with mental illness (Oyewumi et al., 2019). Additionally, individuals can take preventive measures such as engaging in regular physical activity, maintaining a healthy diet, and seeking social support.

##### *3.3.1. Conclusion*

Based on the literature review, it is evident that the South-South region in Nigeria is highly vulnerable to the impacts of climate change, including increased risk of infectious diseases - Cholera, Malaria, etc, food insecurity, malnutrition, extreme weather events, heat-related illnesses - heat exhaustion (symptoms like heavy sweating, weakness, dizziness, nausea, headache and can progress to heat stroke if untreated).Heat Stroke (a severe, life-threatening condition with

symptoms like high body temperature (often  $>104^{\circ}\text{F}/40^{\circ}\text{C}$ ), confusion, agitation, slurred speech, loss of consciousness that could require immediate medical attention), heat Cramps ( Painful muscle cramps due to dehydration and electrolyte loss from sweating), heat rash( skin irritation from excessive sweating in hot, humid conditions) and mental health challenges. These impacts have significant implications for the health and well-being of the population, as well as for the region's economic and social development.

Therefore, Digital Citizen Science Observatories Laboratory (DCSOL) can play a crucial role in addressing these challenges by providing a platform for community-based monitoring and data collection. By engaging citizens in the process of data collection and analysis, DCSOL can help to build local capacities and empower communities to take action to address their climate change impacts.

Furthermore, DCSOL can facilitate the development of early warning systems for extreme weather events, which can help to reduce the risk of loss of lives and property damage. Additionally, DCSOL can support efforts to improve food security and reduce malnutrition by providing real-time data on crop yields and soil moisture levels.

In summation, the Digital Citizen Science Observatories Laboratory has the potential to be a valuable tool in addressing the impacts of climate change in the South-South region of Nigeria. By engaging citizens in the process of data collection and analysis, DCSOL can help to build local capacity and empower communities to take action to address climate change impacts, ultimately leading to a more resilient and sustainable future for the region.

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#### **4. Rationale for the use of digital citizen science observatories laboratory for intervention in public health problems due to climate change in the south-south region of Nigeria**

Climate change is a global phenomenon that has been affecting the world in various ways. The South-South region in Nigeria is not an exception to the effects of climate change. The region has been experiencing increased risk of infectious diseases, food security and malnutrition, extreme weather events, heat-related illnesses and mental health challenges. These challenges have been affecting the livelihoods of the people in the region, and there is a need to find solutions to mitigate their effects. One of the solutions that can be used to address these challenges is the Digital Citizen Science Observatories Laboratory. This paper will provide a rationale for the use of the laboratory to solve the problem of climate change in the South-South region in Nigeria.

##### **4.1. Background**

The South-South region in Nigeria is located in the Niger Delta region and is made up of six states, namely Akwa Ibom, Bayelsa, Cross River, Delta, Edo, and Rivers. The region is known for its rich oil and gas reserves, which have contributed significantly to the country's economy. However, the exploitation of these resources has led to environmental degradation, which has contributed to climate change. The region is also prone to flooding, erosion, and other environmental challenges, which have been exacerbated by climate change.

The effects of climate change in the South-South region in Nigeria have been devastating. The region has experienced increased risk of infectious diseases such as malaria, cholera, and dengue fever. This is because climate change has led to changes in temperature and rainfall patterns, which have created favorable conditions for the breeding of disease vectors. The region has also experienced food insecurity and malnutrition due to changes in rainfall patterns, which have affected agricultural production. Extreme weather events such as floods and droughts have also affected the region, leading to loss of lives and property. Heat-related illnesses such as heat stroke and dehydration have also been on the rise in the region. Finally, mental health challenges such as depression and anxiety have been reported in the region due to the effects of climate change.

##### **4.2. The Digital Citizen Science Observatories Laboratory:**

The Digital Citizen Science Observatories Laboratory is a platform that allows citizens to participate in scientific research. The laboratory uses digital technologies such as mobile phones, sensors, and social media to collect data on various environmental parameters such as temperature, rainfall, air quality, and soil moisture. The data collected is then analysed using machine learning algorithms to generate insights that can be used to address environmental challenges.

The Digital Citizen Science Observatories Laboratory can be used to address the challenges of climate change in the South-South region in Nigeria in the following ways:

#### **4.3. Monitoring of environmental parameters**

The laboratory can be used to monitor environmental parameters such as temperature, rainfall, air quality, and soil moisture. This data can be used to generate insights on the effects of climate change in the region. For example, the laboratory can be used to monitor changes in temperature and rainfall patterns, which can be used to predict the occurrence of extreme weather events such as floods and droughts. This information can be used to develop early warning systems that can help to mitigate the effects of these events.

#### **4.4. Disease surveillance**

The laboratory can be used to monitor the occurrence of infectious diseases in the region. This can be done by collecting data on disease vectors such as mosquitoes and ticks. The data collected can be used to generate insights on the occurrence of diseases such as malaria, cholera, and dengue fever. This information can be used to develop strategies to control the spread of these diseases.

#### **4.5. Agricultural monitoring**

The laboratory can be used to monitor agricultural production in the region. This can be done by collecting data on soil moisture, temperature, and rainfall. The data collected can be used to generate insights on the effects of climate change on agricultural production. This information can be used to develop strategies to improve agricultural production and food security in the region.

#### **4.6. Heat-related illness monitoring**

The laboratory can be used to monitor the occurrence of heat-related illnesses in the region. This can be done by collecting data on temperature and humidity. The data collected can be used to generate insights on the occurrence of heat-related illnesses such as heat stroke and dehydration. This information can be used to develop strategies to prevent the occurrence of these illnesses.

#### **4.7. Mental health monitoring**

The laboratory can be used to monitor the occurrence of mental health challenges in the region. This can be done by collecting data on social media platforms and mobile phone applications. The data collected can be used to generate insights on the occurrence of mental health challenges such as depression and anxiety. This information can be used to develop strategies to address these challenges.

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### **5. Conclusion**

The Digital Citizen Science Observatories Laboratory is a Human Centred Designed (HCD) platform that can be used to address the various challenges of climate change and poor vaccine access in the South-South region in Nigeria. The laboratory can be used to monitor environmental parameters, disease surveillance such as malaria, cholera, Mpox, Meningitis, etc, agricultural monitoring, heat-related illnesses monitoring, and mental health monitoring. The data collected can be used to generate insights that can be used to develop strategies to mitigate the effects of climate change as well create demand for prompt Primary Healthcare services particularly vaccine uptake in the region. It will be able to provide early warning signs and prompt response. Therefore, the laboratory is indeed very apt in addressing the challenges of climate change and various health challenges amongst the Most vulnerable Places in the South-South region in Nigeria. The laboratory will definitely have a multiplier effects and highly impactful on the livelihood of the communities in particular and the zone in general. Engaging communities in South-South Nigeria's rural areas through Digital Citizen Science for strategic mitigation of Malaria, Cholera, and heat-related illnesses due to climate change can lead to enhanced community resilience and the Communities empowered with knowledge and tools for decision-making on climate-related health risks. It will also result to improved health outcomes as better management and mitigation of climate-sensitive health issues through community-led interventions and invariably bridge data gaps. Digital Citizen Science can fill gaps in climate-health data in rural settings.

#### *Recommendations*

- This recommends the imperative of Implementing Digital Citizen Science: Utilize Digital Citizen Science to engage communities in monitoring and mitigating climate impacts on health.
- Capacity building: Ensure communities have necessary skills and resources for effective engagement in Digital Citizen Science.

- Focusing on vulnerable populations: Interventions are targeted towards most vulnerable populations in rural South-South, Nigeria.
- Monitoring and evaluating: Continuously monitoring and evaluating outcomes of Digital Citizen Science interventions for adaptive management.

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