BioSocial Health J. 2025;2(1):x-x
doi:10.34172/bshj.48
https://biosocialhealthjournal.com

BioSocial
Health Journal

Original Article

Climate Change and Flooding nexus: Water, Sanitation, and Hygiene (WASH) and Mental Health implications in Fuveme, Ghana

Ruth Dzokoto[1,2], Mercy Paintsil[1,2], Elijah Kwasi Peprah[1,3*], Seth Ahiabor[1], Forgive Awo Norvivor[1]

[1]Department of Epidemiology and Biostatistics - Fred N. Binka School of Public Health, University of Health and Allied Sciences
[2]Green Dialogue Africa
[3]Department of Environmental Health - Accra School of Hygiene, Korle-Bu, Ghana

***Corresponding Author:** Elijah Kwasi Peprah, Email: peprahelijahkwasi63@gmail.com

Abstract

Introduction: Climate change refers to long-term temperature shifts driven by anthropogenic activities, resulting in extreme global weather patterns. These events include increased flooding disasters exacerbated by rising sea levels, coastal erosion, and tidal waves in coastal communities affecting access to water, sanitation, and hygiene (WASH), where LMICs in Sub-Saharan Africa bear a disproportionate brunt of climate action. This study explored the implications of climate induced flooding disasters on Water, Sanitation, Hygiene, and Mental health in the Fuveme-Keta District of the Volta Region, Ghana.

Method: An ethnographic qualitative approach was employed to collect data among eleven, purposively sampled key stakeholders and household heads, who consented to be interviewed. In-depth Interviews were audio recorded, transcribed using ATLAS.ti, and thematically analyzed.

Results: Perennial flooding and storm surges destroy drinking water sources and access points, hygiene amenities, and sanitation (toilet) facilities. There is anxiety at the hint of rainstorms and depressive tendencies due to the loss of livelihood, family members, and property. Self-comfort and family support were the main coping mechanisms.

Conclusion: The community's strong attachment to their ancestral home and the limited options for alternative livelihoods, pose significant challenges for adaptation and resilience. Climate-resilient WASH infrastructure, specific mental health interventions, and alternative livelihood support are needed to improve resilience.

Keywords: Climate change, WASH (water, sanitation, and hygiene), Flood, Mental health, Coastal communities, Ghana

Received: November 21, 2024, **Accepted**: November 29, 2024, **ePublished**: xx xx, 2025

Introduction

Climate change refers to significant and lasting changes in Earth's climate patterns, mainly driven by human activities sch as burning fossil fuels, deforestation, and industrial processes. This increases greenhouse gases in the atmosphere, causing global warming and altering weather patterns. Its effects include rising temperatures, melting ice caps, more frequent and severe weather events, and shifts in ecosystems and wildlife populations. Additionally, climate change has intensified extreme weather events and exacerbated numerous public health issues, such as the spread of infectious diseases and respiratory problems, posing a global challenge for nations, states, and territories.[1] Globally, these long-term changes in global temperatures and weather patterns in recent decades have been much higher and have risen faster in recent years.[2] River and lake ice are breaking up earlier, and glaciers and ice sheets are shrinking.[3-5] The frequency of these extreme weather events transforms environments and is disastrous, particularly within coastal communities, and has major implications.[6] For instance, the continuously rising sea level endangers several coastal towns and cities in Ghana. Climate change disasters are characterized by less rainfall, frequent and severe floods, cyclones, storms, tidal surges, water intrusion, and coastal erosions, forcing many coastal dwellers to face multiple problems with drinking water, sanitation, and hygiene (WASH) with the developing countries in Africa bearing disproportionate brunt of the burden.[7]

Research by Zakaria,[8] in coastal Ghana revealed that 65% of residents reported significant anxiety symptoms related to water insecurity, with a strong correlation between chronic water stress and depressive symptoms. With a changing climate, an appropriate understanding of its impact on water resources and sustainable livelihoods in semi-arid regions is crucial to sustainable economic development and social transformation.

This research is particularly important and contributes to highlighting the impact of climate change on household water shortages and how climate change affects the mental health of vulnerable people. Previous studies have explored the impact of climate change on water availability

for households, sanitation, and hygiene in Ghana, but barely focused on how Climate change holistically affects specific vulnerable populations in coastal communities using ethnographic qualitative approaches.

While existing research has examined climate change impacts on water availability, sanitation, and hygiene in Ghana, several critical research gaps remain. For instance, previous studies have largely focused on general population impacts, with insufficient attention to marginalized groups in coastal communities.[9] While researchers like Hambrecht et al[10] have documented broad climate change effects on coastal regions, a significant gap in understanding how socioeconomic vulnerabilities intersect with climate impacts. Particularly, women, children, the elderly, and economically disadvantaged groups in coastal communities face unique challenges that are inadequately captured in current literature.[11] For instance, Tetteh et al[12] note that while general climate adaptation strategies have been studied in Ghana, specific interventions targeting vulnerable populations remain understudied. Also, the psychological dimension of climate-induced water insecurity represents a significant knowledge gap. While physical health impacts are well-documented, mental health consequences remain understudied.[13] Limited research by Adams and Nyantakyi-Frimpong.[14] suggests significant psychological distress in communities facing water insecurity, but comprehensive studies in coastal Ghana are lacking. Hunter et al[15] note that existing mental health research in climate-affected areas focuses primarily on post-disaster trauma, neglecting chronic stressors associated with ongoing environmental changes.

Therefore, this study seeks to address these gaps by exploring the nexus between climate change, WASH, and mental health in the Fuveme-Agorkedzi, Keta District of Volta Region.

The framework adapted in this study provides a structured approach to addressing the challenges posed by climate change on water use, sanitation, hygiene, and mental health in Fuveme-Agorkedzi, Keta District, Volta Region of Ghana. It emphasizes the importance of multi-sectorial collaboration, community involvement, and continuous monitoring to build resilience and improve the well-being of the affected population (Figure 1).

Methods

Participation and procedures

A descriptive qualitative method (ethnographic method) is the research design used in this study; the qualitative research method, provides researchers with the best opportunity to comprehend the innermost deliberation of research participants' "lived experiences. Ethnography is a method of investigation derived from anthropology and sociology whereby the researcher studies the communal patterns of behavior, language, and actions of an intact cultural group in a natural situation over a protracted period.

Eleven participants who were male or female-headed household heads were purposively sampled for this study; this approach targets qualified participants. Household heads who have stayed in the study community for most

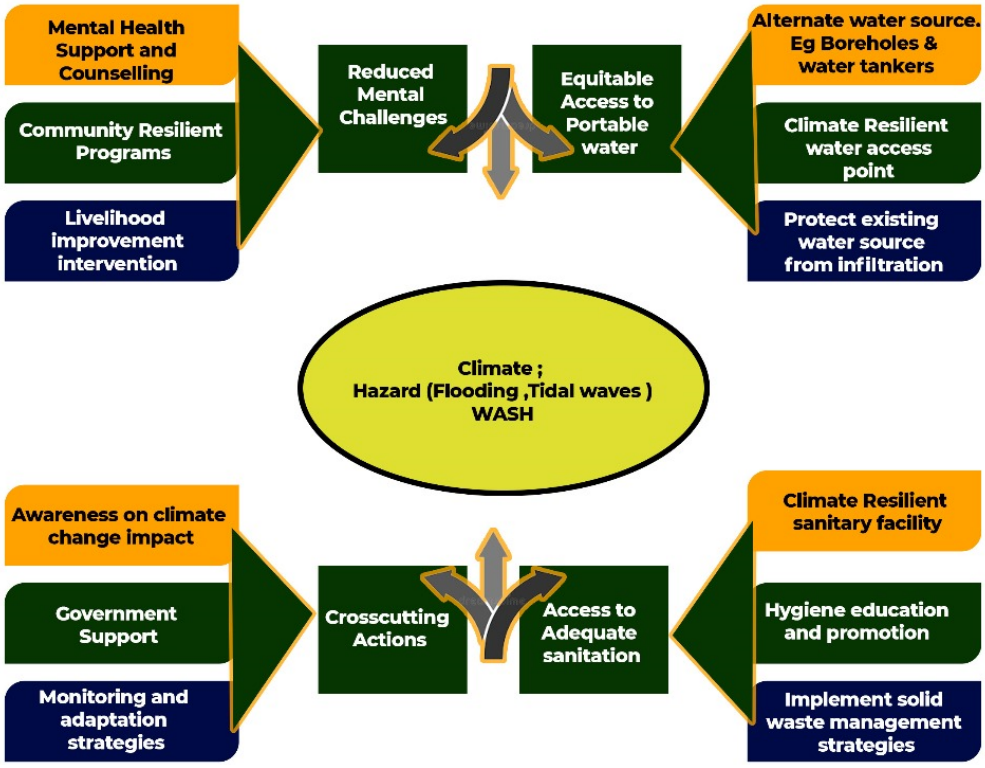

Figure 1. Framework for climate change, health, and resilience

parts of their lives, have experienced any climate-induced events within the community, and can provide adequate information on climatic historical events were included in this study.

Sampling

The sample size for this study was based on saturation. This means that the recruitment of participants for the study only ended when the researcher recognized that the issues being reported by the participants had become the same and no new information emerged from further interviews.

Inclusion criteria

The study included key stakeholders and household heads who are aged 18 and above years, who are residents of the Fuveme community, available during the time of the data collection, and who were willing to participate in the study.

Exclusion criteria

All key stakeholders and household heads who were qualified to be included in the study but did not consent, were sick, mentally challenged, deaf and dumb, and were not able to communicate clearly during the data collection, were excluded.

Interview procedure

Participants were interviewed face to face, either in their homes or workplace using an In-depth interview guide to gather information on socio-demographic characteristics, climate change impact on water use, sanitation, hygiene, and mental health. Handwritten notes and audio recorders were used to record responses. The trustworthiness and reliability of the interview guide was evaluated; this was done by reviewing the questions and probes; this ensured uninterrupted interviews and reliable data.

Qualitative research analysis procedure

Interviews were transcribed, and codes and themes were developed using ATLAS.ti. v9. Data was familiarized, and coding was done inductively and deductively, using the key findings within the quotes.

Ethical Issues

Ethical approval for the conduct of this study was obtained from the University of Health and Allied Sciences Review Committee and authorization from Municipal health directorates of Keta Municipality. Written informed consent was obtained from participants before including them in the study. This was done by giving them informed consent forms to sign, indicating their willingness to participate in the study.

The purpose of the study was explained to them before interviewing them. They were informed of their right to stop at any point in time of the interview process when they felt so and assured them that any statement or comments including that of privacy remained protected. Due to the sensitivity of the topic under study, the participants were given code names to conceal their actual identities. The recorders that were used for the interviews were encrypted and accessible to only the principal investigator. Apart from the time participants spent during the interview, there were no risks associated with participating in this study. There are also no individual benefits or rewards for taking part in the study.

Results

The socio-demographic characteristics of the participants indicate that most (45.6%) were aged 30–49 years. A significant majority (81.8%) were married, and females constituted 54.6% of the participants. In terms of education, 36.4% had completed junior or senior high school. Regarding occupations, 27.3% were civil servants, fishermen, or traders (Table 1).

Thematic analysis revealed 11 key themes, including knowledge of climate change, its impact on WASH, access to toilet facilities, availability of handwashing materials, and the overall community impact. Other themes covered drinking water sources, prevalent diseases, mental health effects, coping strategies, reasons for returning after disasters, and challenges with sea defense measures in preventing flooding (Table 2).

Regarding the community members' general knowledge

Table 1. Socio-demographic characteristics of the participants

Variables	Frequency	Percent
Age (y)		
<30	2	18.0
30-49	5	45.6
50+	4	36.4
Sex		
Male	5	45.4
Female	6	54.6
Education level		
No formal Education	1	9.0
JHS	4	36.4
SHS	4	36.4
Tertiary	2	18.2
Marital status		
Never married	2	18.2
Married	9	81.8
Occupation		
Civil servants	3	27.3
Fisherman	3	27.3
Fishmonger	2	18.1
Trader	3	27.3

Table 2. Themes and sub-themes

Main Themes	Sub-themes
Climate change and WASH impacts	• Destruction of drinking water sources and facilities • Limited access to toilet facility • Open defecation
Primary source of drinking water	• Pipe borne water
Alternative source of drinking water	• Sachet water
Availability of hand washing facilities	• Not available
General impact of climate change on the community	• Destruction of school blocks. • Destruction of homes
Health implications	• Malaria • Hypertensive tendencies • Skin infection (Water washed diseases) • Limited access to primary health care
Mental health implications	• Depressive tendencies • Traumatic experiences and Anxiety
Coping	• Family support • Self-comfort
Reason for returning to community following forced displacement after flooding disaster	• Ancestral/cultural attachments • Source of Livelihood • Nowhere else to go
Reason for persistent flooding	• Limited adaptation, climate resilience and mitigation interventions in the community

of climate change, it was noted that most community members interviewed in this study had fairly good knowledge about the signs of changing climate. They indicated that it was a change in the environment from its natural state compared to past occurrences, characterized by the rise in sea level, irregular rain patterns, and droughts. The following quotes summarize some of their responses:

"What I am seeing now is, at first when we were kids, the sea did not chase us but right now the level of the sea has risen to a very high level and it is chasing us from where we live to this place and when you are looking for those places, you will see them in the sea. So, I have realized that it is climate change occurring" (Male, 40 years, Fisherman)

"Change in environmental factors which can be checked with recorded weather events for some time. Climate change now can be linked to human factors. Industrial emissions, transport, etc." (Male, 21 years, Civil servant).

Vis-à-vis, the impact the climate change is having on WASH activities in the community, it was found that rising sea levels result in flooding, destroying toilet facilities in the community leaving them limited options and access to any toilet facility, and therefore resort to open defection in the bush and the seashores. The quotes below represent some of the community members' responses:

"With regards to toilet facilities, since I was born there has never been a public toilet, but in 2008-2009, one was constructed for the school in the community and that was what we all used until the sea took it again. Some sanitary officers, from the local assemblies, promised to build us a public toilet recently but we have not heard from them. Women and men have to be clashing at the seashore because of this which isn't something we are proud of as men but we cannot do anything about it." (Male, 46 years, Fisherman)

"Some time ago, we used to have toilets but the sea took it all away to the extent the current generation does not know there was a toilet ever in this community." (Female, 87 years, Fishmonger)

It also emerged that, the change in tidal waves, which is characteristic of Climate action had destroyed available sources of water. The community members bemoaned that household wells and boreholes which served as either their major sources of water in the community, had been completely taken by the seawater or the wells were infiltrated with seawater making it salty and unable to be used for drinking or household purposes. The following quotes summarize some of their responses:

"…once the sea rises, we start to experience coastal flooding, and our wells are infiltrated with sea water leaving it undrinkable or even we cannot use for anything in the house" (Male, 44 years, Fisherman).

"With regards to access to water, we do not have wells unlike first. It was 2004 when pipelines were laid for us. Even with that, the sea has taken half of the pipelines. Also, if you do not store water, you will be found wanting when there is no pipe flow which happens a lot in this community." (Male, 46 years, Fisherman).

The community uses pipe-borne water from the adjacent community, but requires payment for access or fetching. Some members struggle to pay for water and rely on sachet water as an alternative. The destruction of wells and boreholes has limited access to potable water, affecting their daily activities.

"As for water, we have pipe-borne water in the nearby

community and it is sufficient for drinking only that when they close it, we do not have any storage, so we suffer getting water." (Male, 44 years, Fisherman).

"After the sea destroyed our wells, we get a pipe which was constructed like a poly tank, we buy it, and if they close it or you do not have money you will not get water so I use sachet water sometimes." (Male, 40 years, Fisherman).

Regarding the availability of hand washing facilities in the community, it was noted that currently there is none at all. However, the community members explained that they used to have some hand washing facilities during the peak of the COVID-19 pandemic, but now all those facilities have broken down or destroyed by the seawater. The following quotes summarize some of the responses from the community members:

"Not anymore! Now we do not have any hand washing material here in the community, they used to be there during the COVID-19 era, but they are all destroyed now" (Male, 44 years, Fisherman)

"Hand washing facility? Yes, during the COVID-19 time we have some place in the community for hand washing but now No, it got broken and we do not have any available" (Female, 55 years, Fishmonger).

Almost all of the community members lamented how community schools and people's houses were destroyed by the flood, resulting from climate change. The quotes below represent some of their responses:

"The buildings get destroyed permanently with the sea taking their place and those who remain in shape are re-occupied although with some fear. This is the 4th place we have relocated to and it happens to be our last stop because there is nowhere else to go to" (Male, 44 years, Fisherman).

"It destroys some buildings but by the grace of God, it does not happen to everyone suddenly and it happens mostly in the morning or afternoon so we are able to move our things to our neighbors. At first, we used to have a lot of block buildings but what is left to us now are temporary structures made from coconut branches." (Male, 40 years, Fisherman).

Community members unanimously identified malaria as the predominant disease affecting them. They attributed this to the flooding, which leads to a rise in the mosquito population, resulting in more mosquito bites and subsequent malaria infections. Additionally, some community members reported that insect bites lead to skin diseases, while others suffer from hypertension, because of overthinking and anxiety. The following quotes summarize some of their responses:

"There is the prevalence of mosquitoes after the flooding from the sea leading to malaria and we recently experienced some strange skin disease this year and we do not know where it is coming from. Some people also have high blood pressure from their consistent overthinking" (Female, 63 years, Fishmonger).

"Mosquitoes are killing us, the mosquitos become plenty when there is flooding, they are everywhere and we get malaria, I have experienced cholera outbreak before but not in recent times, also, a lot of people in this community have hypertension." (Female, 87 years, Trader).

The destruction caused by climate change has significant mental health implications for community members. Household heads interviewed reported experiencing major mental health issues, such as depression and anxiety, due to the loss of their properties. Additionally, some individuals become psychologically traumatized by witnessing their livelihoods being destroyed overnight. The quotes below summarize some of their responses:

"Yes, when you look at the building (talking of their coconut leaves weaved for buildings) in which I am in now, that is not what I wish to be in and it applies to everyone in this community. We built with cement blocks and the sea has succeeded in destroying them when it happens like that, it worries our minds a lot. We think a lot and every day, this makes us depressed, you know it is not easy seeing what you worked for many years destroyed like that" (Male, 44 years, Fisherman).

"That is one of our serious issues here. I am a regular visitor to the health facility in our neighboring community. As an individual, you cannot imagine the intensive thinking I do because of this coastal erosion. As young as I am, I have heart attacks sometimes. In truth, you can be in bed at midnight and suddenly, the sea is under your bed, and where to even pass becomes a critical issue. A lot happens mentally like people become depressed and sad every day." (Female, 37 years, Civil servant).

To cope with the challenges and trauma they have faced, community members highlighted that their primary coping strategies involve support from their families. They also rely on self-comfort to manage the difficult situations arising from the destruction of their properties and livelihoods. The quotes below summarize some of their responses:

"…when it happens like that, some people go to their families which are not yet affected while looking for another place but if it happens right now, I do not believe that even if we go to our families or neighbors, we will get another place to build as we have done currently. But our families give us the support we need and this support helps us cope with our pains for sometimes" (Male, 44 years, Fisherman)

"Well, there is no savior anywhere so we comfort ourselves because it is not as if there will be any help from anywhere if you continually think about it. It is better to live and fight another day. What the community wants is for a savior to come and construct a sea defense for them because we are already here, if they take us somewhere, what are we going to do there?" (Male, 40 years, Fisherman).

When the community members were asked the reasons why they always return to the same place after fleeing from the community after a disaster, most of them indicated that the place is their ancestral root, so they have nowhere else to go. Others also explained that the community is where their livelihood is and they have no other work elsewhere they can do better than the fishing. That is what they have been taught and doing for many years. The following quotes present some of the community members' responses to this:

"You know we started our journey from somewhere and this is our last stop like I said earlier, we have been moving forward from somewhere to this place, and trust me if I say the greater part of the community is in the sea and this is just a portion you are seeing. If I should point out something to you, our sources of livelihood are here; if we leave, what work are we going to do to feed our families? It is not only about any ancestral root." (Male, 40 years, Fisherman).

"It is our livelihood. There is no job anywhere for us if we decide to leave the seashore; moreover, we do not know of any other work aside the fishing and trading" (Female, 37 years, Civil servant).

Discussion

Impact of climate change on water use, water and sanitation facilities

The coastal community of Fuveme, lays bare the vagaries of climate action (Figures 2 and 3) characterized by storm surges and coastal erosion which was earlier reported by Fitton et al.[16] The destruction left behind is exacerbated by the inability of coastal settlements to recover from climate change because adaptation and resilience rely heavily on having access to a variety of resources, which many small coastal communities lack or are woefully inadequate, even if available.[17]

Meanwhile, it is evident from this study, that community members can unexplainably see their community being submerged, characterized by drastic environmental changes, and pointing its potential causes to human activities, similar to what.[18]

Fuveme, a once vibrant community is quickly becoming disserted, rising sea levels and coastal flooding forcibly displacing inhabitants, have led to the destruction of toilet facilities; this has resulted in open defecation and violation of dignity and privacy of community members as stated in (Table 1). The lack of adequate sanitary facilities is a pressing concern that must be addressed urgently as this can lead to the spread of infectious diseases as stated in (Table 2). Fuveme community members have been left behind in achieving SDG 6, meanwhile, the goal indicates a "leave no one behind" approach.

Fecal contamination of the main water sources, which are shallow hand-dug wells is eminent due to surface run-off into the unprotected water source making it unwholesome for human consumption. Seawater intrusion as reported by Norvivor et al[19] is a major concern for coastal community dwellers; Climate change also further worsens access to clean drinking water, by the contamination of wells and boreholes by seawater following these storm surges in Fuveme. This is consistent with the findings of Lindsey and Dahlman[2] which stated that climate change threatens the quality of water and safe water provision. The study emphasizes the urgent need for adaptive measures and climate-resilient infrastructure to address these issues.[20] Addressing climate change's impact on WASH is not just an environmental concern but a matter of social justice and human well-being.

The destruction of water facilities within coastal communities negatively affects access to clean drinking water and affects hygiene practices like hand-washing.[21]

The lack of reliable water infrastructure and accessibility as well as the absence of hand-washing facilities are significant concerns in Fuveme, particularly among children in the school as lamented by a head teacher. The lack of accessible facilities, such as hand-washing facilities, can compromise hygiene practices and increase the risk of infections.[22]

Figure 2. Destroyed classrooms

Figure 3. Destroyed classroom and sanitary facilities

Figures 4. Socioeconomic implications

Figures 5. Climate action implications at the coast of climate action

The destruction of houses and schools in Fuveme during flooding also highlights the broader impacts of climate change on community infrastructure, education, and living conditions. This frequent destruction of facilities forced displacement and loss of permanent structures has led to instability and economic hardships; as earlier mentioned by Fitton et al,[16] the once vibrant Fuveme fishing community is gradually being lost due to increasing coastal erosion and flooding.

Increasing mosquito populations and the prevalence of malaria due to flooding underscore the public health risks associated with climate change.[23] Proactive measures are needed to control vector-borne diseases and address mental health impacts from environmental stressors.[20] Prioritizing mosquito control programs and community health initiatives is crucial to safeguard community well-being.[24] Overall, climate change-induced environmental changes and the need for holistic approaches to safeguard community well-being are essential for addressing these challenges.[25]

Influence of climate action on mental health

The study highlights the significant mental health implications of climate change-induced destruction on communities, particularly household heads, who experience solastalgia, a term coined by Glenn Albrecht describing homesickness despite being at home, caused by environmental changes like droughts, floods, and fires. This emotional toll disrupts cultural ties between people and their land. Many residents remain in these areas due to socio-cultural attachments and the mental burden of being climate refugees within their own country.

The distress manifests as eco-anxiety, panic, and fear at the sight of changing weather, with ecological grief arising from disasters. This deteriorates overall well-being and reduces coping capacity. Coping mechanisms primarily involve family support and self-comfort, consistent with findings by previous research.[26,27] Community members' attachment to their ancestral roots and dependency on fishing livelihoods explain their resilience in returning to disaster-prone areas.

The study underscores the urgency of addressing disaster-related mental health consequences through support and resilience-building efforts, as emphasized in prior research, by Oliver-Smith.[28]

Limitations of the study

The study acknowledges several limitations. Generalizations cannot be made due to its focus on key stakeholders and purposive sampling, which also limits the findings to associative rather than causal effects. While in-depth interviews and purposive sampling may have introduced response and selection biases, these were minimized through well-designed data collection instruments with probes.

The study does not provide diagnostic conclusions about mental health conditions as the researchers were not mental health experts, though mental health impacts were a recurring theme among participants. Further research is recommended to explore these impacts in vulnerable populations.

Sociocultural barriers during data collection included reluctance from women in single-headed households to participate, as they were not culturally recognized as household heads. This exclusion potentially limited valuable insights.

Conclusion

Climate change-induced sea level rise and flooding have severely impacted Ghana's Fuveme community in the Volta Region. Periodic flooding and storm surges have destroyed wells and pipe-borne water supplies, while seawater intrusion has rendered hand-dug wells unusable, limiting access to clean water.

Sanitation infrastructure has also been devastated, with extreme weather events destroying toilet facilities and forcing residents to practice open defecation. These challenges have adversely affected sanitation, hygiene, and

mental health, with anxiety and depression emerging as significant concerns.

Community members rely on coping mechanisms such as family support and self-comfort to endure the trauma of losing homes and livelihoods. Mental health support systems are essential to address the impacts of climate change on affected populations.

Recommendations

The findings from this study made it imperative to make the following recommendation:

Alternative livelihoods should be created.

Interventions such as climate-resilient water facilities need to be implemented by local authorities to address the water quality and quantity issues faced by coastal communities.

Climate-resilient sanitation facilities should be constructed by local authorities in affected communities to prevent open defecation.

Non-governmental Organizations focused on the education and well-being of children and vulnerable populations can consider including small coastal communities affected by climate change in WASH interventions to provide hand-washing facilities within the community and schools to promote hygiene and education.

The Ghana Health Service should design emergency programs that provide psychological support to flood victims and those affected by the impacts of climate change.

It is important to also important for relevant stakeholders to take emergency measures to address climate by adopting green strategies and interventions to reduce reliance on fossil fuels.

Acknowledgments

We are grateful to the people of Keta Municipality for participating in this study. We would also like to thank the editor of this journal for the tremendous effort.

Authors' Contribution

Conceptualization: Forgive Awo Norvivor.
Data curation: Ruth Dzokoto, Mercy Paintsil.
Formal analysis: Seth Ahiabor.
Investigation: Ruth Dzokoto, Mercy Paintsil.
Methodology: Forgive Awo Norvivor.
Project administration: Forgive Awo Norvivor.
Supervision: Forgive Awo Norvivor.
Writing-original draft: Ruth Dzokoto, Mercy Paintsil, and Elijah Kwasi Peprah.
Writing-review & editing: Elijah Kwasi Peprah, Forgive Awo Norvivor.

Competing Interest

The authors declare no competing interests.

Ethical Approval

This study was ethically approved by the University of Health and Allied Sciences Review Committee and Keta Municipality's Municipal health directorates. Participants were given written informed consent, informed of the study's purpose, and given code names to conceal their identities. Interview recorders were encrypted and the data collected was protected. There were no known risks or individual benefits associated with participating in the study.

Funding

This study was not externally funded by any institution.

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