UNIVERSITY TEACHERS ASSOCIATION OF GHANA (UTAG), NATIONAL

A Rapid Assessment of the Impact of the

AKOSOMBO DAM SPILLAGE

in Selected Communities of the Volta Region



November 2023

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Executive Summary

The overflow of the Akosombo Dam has resulted in widespread flooding in communities along the Volta River, leading to the displacement of households. A crisis that has inflicted hardship and posed challenges for the people residing in the riparian zone. In response to this crisis, the University Teachers Association of Ghana (UTAG) assembled an expert panel to conduct a rapid impact assessment study in the affected communities. The primary goal was to gather initial evidence for a more comprehensive longitudinal study that could effectively inform policy development and strategic interventions. The rapid assessment covered various dimensions, including the impact of the flood on health, food and nutrition security, mental health, support systems and coping strategies, water, sanitation and hygiene, infrastructure damage and shelter, agriculture and livelihoods, teaching-learning environment, and academic performance, as well as demographic and biophysical factors. The team visited two severely affected communities, Mepe, Battor, and Sogakope, in the North Tongu District. A combination of qualitative and quantitative data collection tools, such as observations, surveys, water quality tests, and anthropometric assessments, was employed.

Fortunately, there were no immediate physical injuries or deaths directly attributed to the floods. However, significant disruptions in accessing healthcare services were noted, as health facilities were submerged and rendered dysfunctional. The flooded roads further hampered mobility and access to facilities outside the affected communities. Clean drinking water was scarce, with water quality tests indicating contamination of pipes and boreholes. Victims resorted to drinking sachet water, and concerns were raised about potential waterborne diseases and cholera due to contaminated water sources. Sanitation challenges were evident, with limited access to toilets leading to open defecation in some areas. The floods also took a toll on mental and psychological well-being, increasing the risk of trauma, stress, insomnia, hypersensitivity, anxiety, and depression. Food and nutrition security were compromised as households lost their reserves, and donated food lacked diversity. Schools faced closures for over three weeks, with facilities transformed to accommodate displaced families, disrupting teaching and learning. The flood also impacted the psychological well-being of students. Teaching and learning materials were destroyed, further hindering academic progress.

The findings demonstrate inadequacies and inefficiencies in emergency response mechanisms and strategies provided to the affected communities making it necessary to generate empirical evidence to inform effective responses to emergencies in the country. The rapid assessment highlights a severe emergency with risks to health, education, water quality, the environment, sanitation, and mental health. It emphasizes the necessity for improved early warning systems and reveals shortcomings in the fundamental policies underpinning disaster risk reduction. Furthermore, these rapid findings underscore the urgent need for an extensive longitudinal study covering all affected communities to provide a comprehensive understanding of the situation for informed responses and policy decisions.

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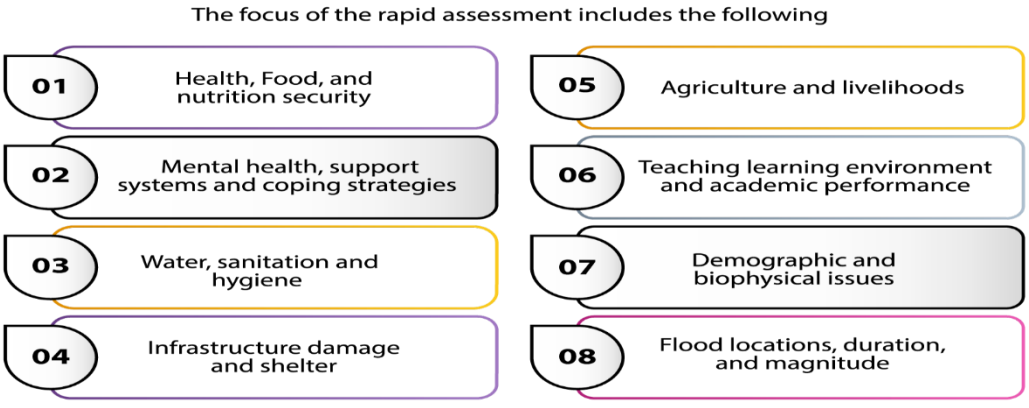
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1.0 Introduction

Between the 15th of September and the 30th of October 2023, the Volta River Authority, which operates the 1,020-megawatt Akosombo Dam, initiated the opening of the dam's spillways. This action aimed to prevent the reservoir's water from surpassing the dam's capacity, mitigating the risk of catastrophic dam failure. In the months leading up to the spill, the dam catchment experienced a substantial increase in rainfall, elevating water levels near the dam's maximum operating level of 84.40 meters. By September 15, 2023, when the spilling began, the water level reached 83.06 meters. The spillage began at a discharge rate of 566 cubic meters per second (m3/s) and escalated to almost 5,200 cubic meters per second.

Following the release of excess water from the Akosombo Dam, numerous communities downstream along the Volta River were inundated. Estimates of the affected population vary, with some reports suggesting that at least 36,000 people have been displaced, and 150 rural communities are submerged. The flood-affected areas reportedly span 8-9 districts across the Volta, Eastern, and Greater Accra Regions, imposing significant hardships on the thousands displaced from their homes. This flooding has undeniably presented challenges and hardships to the people and communities residing along the riverbanks.

In response to this national emergency, the University Teachers Association of Ghana (UTAG) has mobilized a task force comprising members from all public universities. The task force aims to collaborate with the government and development partners in conducting a comprehensive and extensive study on the impacts of the floods. The goal is to gather insights into the health and livelihood challenges faced by the affected people, thereby informing strategic interventions. UTAG seeks to engage effectively with the government to formulate and implement solutions to address the issue of flooding in the country. It's important to note that the current rapid impact assessment study is constrained to preliminary expert opinions and views derived from on-the-ground observations and interactions with some affected individuals. The forthcoming comprehensive study aims to provide a more in-depth understanding of the situation and guide informed decision-making and policy formulation.



2.0 Methods

2.1 Study area

Following a visual survey of flooding damage between Sogakope and Mepe, it was determined that the latter exhibited the greatest impact of the flooding was on surface and drinking water quality in Mepe, Ghana. Therefore, the research was conducted in Mepe, situated in the North Tongu District of the Volta region. This community experiences a tropical climate influenced by the South-West Monsoons. Mepe encounters two distinct rainy seasons: a major one spanning from mid-April to early July and a minor one occurring from September to November.

The soil type prevalent in the community is moderately coarse-textured alluvial soil along the Volta River. Underneath, there is a layer of heavier clay soils that adversely impacts both surface and sub-surface drainage. This condition makes road development challenging. These soil characteristics have been identified as contributing factors to the recurrent flooding issues faced by the community, as highlighted in a report by the Ghana Statistical Service in 2012.

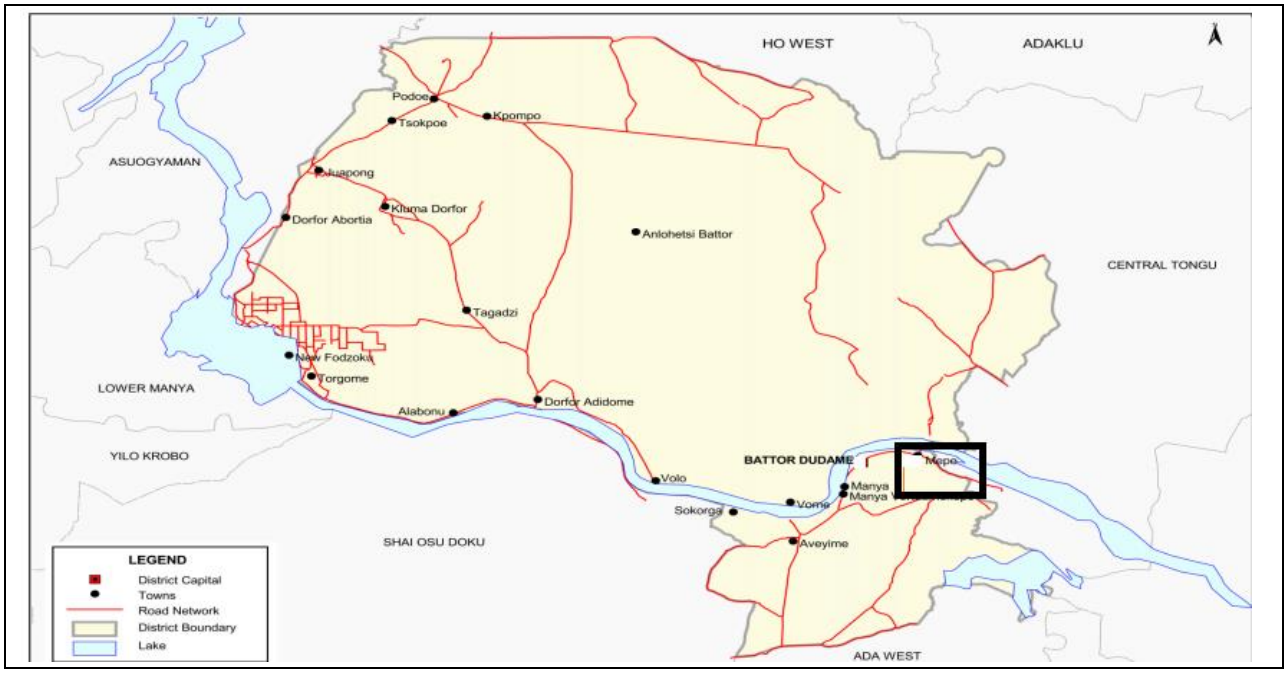


*Figure 1:**Map of North Tongu District showing Mepe.***

Source: https://mapcarta.com

2.2 Research design and data collection

This rapid assessment study employed a comprehensive research approach, integrating both quantitative and qualitative methodologies. Following the recommendation by Grasley-Boy et al. (2022), a situated life-world approach was adopted for data collection and analysis. This design facilitated a thorough exploration of the multifaceted experiences of the disaster victims.

To ensure a nuanced understanding, the study utilized purposive and convenience sampling procedures. The research team visited various sites, including camps and six educational institutions designated as 'safe havens' for displaced families.

Data collection involved a combination of key informant interviews, focus group discussions, and observations. These methods were chosen to gather information on various aspects such as diet, nutrition, education, health, and the experiences related to floods. Additionally, standard tools were employed for nutritional status assessment, including measurements of Mid-Upper Arm Circumference (MUAC), weight, and height. This multi-faceted approach aimed to provide a comprehensive and detailed insight into the challenges faced by the affected population.

2.3 Surface and Drinking Water Quality Assessment

The research team concentrated its efforts on four specific locations within the town of Mepe, as illustrated in Figures 2 and 3. The team collected water samples from distinct sources, including the Volta River, stagnant floodwater within the town, and from two boreholes. Notably, one of the boreholes had been compromised by floodwater.

This preliminary report aims to present data on bacterial counts, nutrients, and heavy metals found in the sampled waters. It is crucial to note that the analysis of pesticides and other pertinent contaminants is currently underway and will be included in subsequent reports.



Figure 2: Google Earth view of the Lower Volta

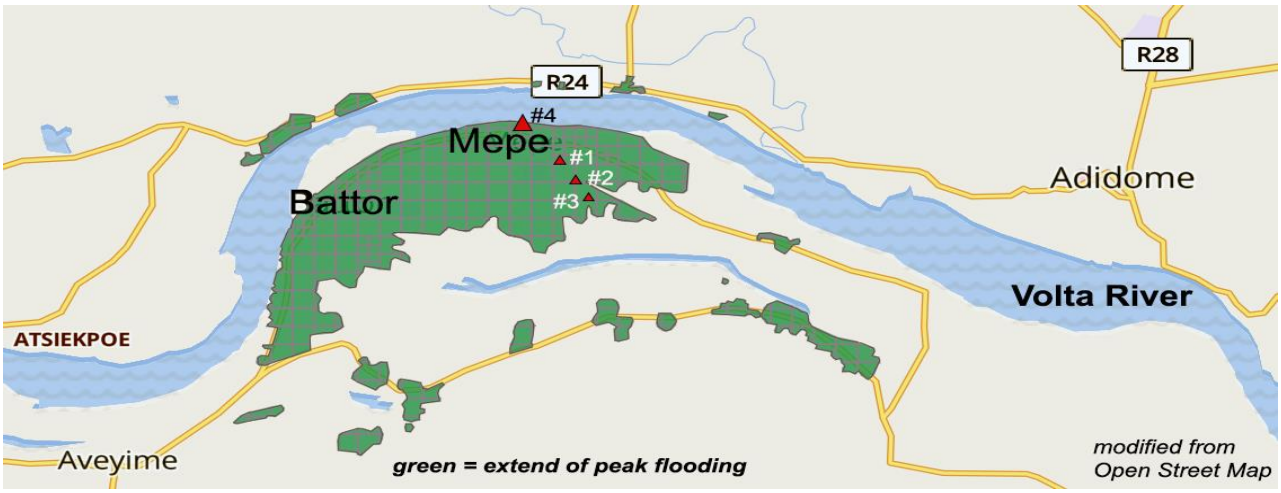


Figure 3: Extent of peak flooding (green) in Mepe and Battor in October 2023).

2.3.1 Site Description

The receding waters allowed for the identification of four sites within the town to represent a gradient of flood impact (Table 1 and Figure 5).

Site 1: was a low-lying area within the town still inundated by stagnant flood water with indications of pollution from flooded cesspools as well as electronic and household waste.

Site 2: was a nearby residential borehole that had been submerged during the height of the flooding.

Site 3: was a residential borehole above the flood line, thus not directly impacted by the flooding.

Site 4: was the Volta River nearshore at a site where residents fetch water.

Table 1. Sampling site characteristics

Site #	Lat	Long	Site description
1	6°04'34" N	0°25'56" E	Stagnant water in low areas of town; impacted by cesspools, shops, e-waste, and household flooding.
2	6°04'31" N	0°25'57" E	The residential borehole was inundated with flood waters during the peak of the flood (receded at the time of sampling). Aquifer 0.5m below ground; water depth 3m.
3	6°04'28" N	0°25'58" E	Residential borehole above the flood line. Aquifer 2m below ground; water depth 1.5m.
4	6°04'51" N	0°25'45" E	Volta River. A water sample was taken approximately 5m offshore adjacent to a staircase used by residents to fetch water.

2.3.2 Water Testing and Sample Collection.

Water quality parameters including temperature, pH, and conductivity were taken at each site concurrent with water sampling using a YSI multi-probe. Water samples were taken either directly with sampling bottles (sites 1 and 4) or from a bucket lowered into the borehole to obtain a large volume of water (sites 2 and 3). Ethanol-rinsed low-density polyethene (LDPE) bottles were used to collect water as follows: three 1L bottles for pesticide and hormone analysis; one 250mL bottle for nutrient and heavy metal analysis; one 30mL bottle for microbiological counts. Once filled (with no air space in bottles), samples were placed into an ice chest returned to the laboratory within 6 hours and stored at 4^{o}C pending further analysis. Samples for pesticide analysis were transferred to the Ghana Standards Authority (GSA). Samples for hormone analysis were solid phase extracted (SPE) within 36 hours of collection and stored at -10^{o}C until further analysis. Microbial analysis and quantification of nutrients and heavy metals commenced within 18 hours of sampling.

2.3.4 Quality Assurance/Quality Control.

Field blank samples (same bottles filled with distilled water the evening before sampling) were taken to all field sites, opened during sampling and reclosed. These samples were analyzed in random order with the samples taken from sites 1 through 4. The YSI multiprobe was calibrated before sampling and re-calibrated the day after sampling to ensure its precision.

Before sampling within household compounds, permission was sought from residents to grant entry onto the premises. We also spent time interacting with the residents of the houses to explain why we were taking the samples and why this was important for the future management of flood-related disasters in the town.



Figure 4: Surface and groundwater sampling sites in Mepe

(A) Site 1 – (B) Site 2 – (C) Site 3 – (D) Site 4

2.3.5 Data analysis

Qualitative data were analysed thematically. The data analysis was derived from the issues probed, taking a cue from Arneson's (2022) argument that interview data can be organized according to the research questions, theoretical framework, or emerging themes. The raw transcriptions were then migrated into Excel format for further categorisation.

3.0 Results

3.1. Observed flood situation

The flooding resulting from the spillage by the Volta River Authority (VRA) on October 12, 2023, had a widespread impact on various communities in the North Tongu district of the Volta Region, Ghana. Notably affected were major towns, including Mafi Adidome, Mepe, and Battor, along with some islands.

Upon interaction with a key focal person in the Mepe community, historical data revealed three significant flooding events due to the spillage of the Volta River since the construction of the Akosombo Dam. The first event occurred in 1963, followed by another in 1970, and the third the most recent event in 2023. Notably, the severity of the spillage and the resulting damage in the current event was reported to be the most extensive.

The elders of the community attributed the heightened severity of the flooding's effects to the substantial increase in residential buildings, particularly in two low-lying areas (valleys) within the community. A visit to the Mepe township confirmed the existence of these low-lying areas along and near the Volta River. Flooding in these valleys posed the most severe impact, with water levels exceeding four meters in some parts of the community (refer to Figure 2).

Observations in the Mepe township revealed that these floodwaters had submerged some older residential buildings entirely, while recently constructed houses were inundated up to their roofing levels. Additionally, most multi-story buildings had their ground floors completely submerged. All water points, including hand-dug wells, boreholes, and public standpipes, were entirely submerged.

Areas heavily affected by the flooding encompassed predominantly residential buildings, cemeteries, community waste dumping sites, major streets, and basic schools. The severity of the flood's impact underscores the urgent need for comprehensive interventions and strategic planning to address the vulnerabilities in the affected community.



Figure 5: Some of the completely submerged residential and basic schools (Online Sources)

3.2. Flood Flow in Mepe

A reconnaissance study of the Mepe community provided insights into the course of flooding, the points of entry for surging water from the Volta River, and the areas significantly affected by inundation. Notably, the spillage of the Akosombo Dam resulted in the elevation of water levels in the Volta River at Mepe to a height exceeding four to six meters (4m-6m).

Two specific locations along the riverbanks, namely Kadzikope (location 1) and Agotigorme (location 2), both suburbs of Mepe along the Volta River from the Battor-to-Mepe direction, exhibited elevations between 3-4 meters above the normal river water level. Surge waters from the Volta River entered through these points, flowing into the first valley situated approximately ten meters away from the riverbank. The water filled this valley along its trench until reaching the intersection with the second valley at Dogorme (location 3), located on the outskirts of Mepe. This area serves as the entry point into the wider and longer second valley (refer to Fig. 3).

The second valley, characterized by a greater width or span, an extended trench, and its lowest elevation at locations 5 and 6, experienced the most severe impacts in terms of damages to inhabitants, buildings, roads, and economic activities. These locations, marked as 5 and 6, bore the brunt of the flooding, witnessing the greatest effects on the community. The clarity in understanding the flow and impact points is crucial for formulating effective strategies and interventions to mitigate future flooding risks in Mepe.

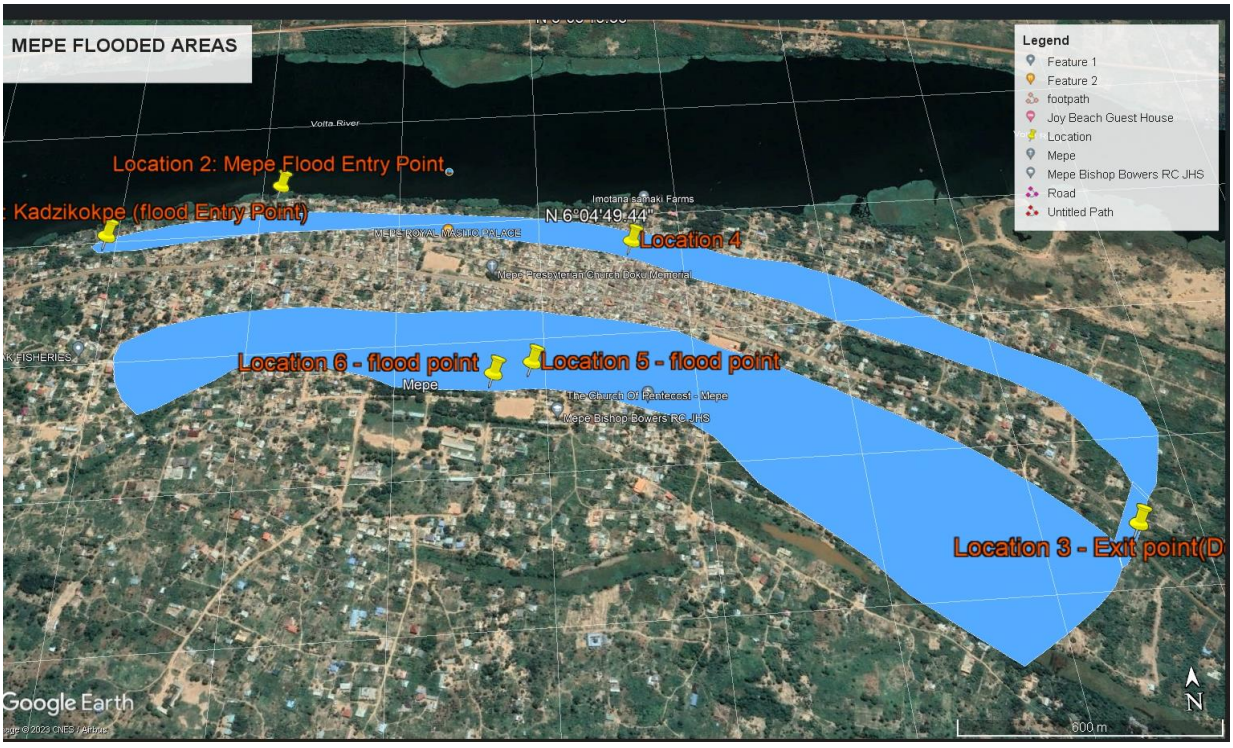


Figure 6: Flood map of Mepe showing the points of entry, the direction of flood flow, and flooding

3.3. Impact of the floods

The rapid assessment also focused on the impact of the flood on health, nutrition, education, and water quality, among others.

3.3.1 Access to health

It appears there were no reports of physical injury or mortality arising directly from the floods. This suggests that, even though there was substantial property damage, there was a good time for people to evacuate their residences. However, there have been significant disruptions in accessing healthcare services in the affected geographical areas. Lower-tier facilities (CHPS compounds and health centres) in the Mepe enclave were submerged in the floods and have thus been rendered dysfunctional, albeit temporarily. Coupled with flooded roads, access to health care for populations that utilise these facilities can become problematic. Again, residents are likely to have lost their NHIS cards amid the floods. These disruptions present different dimensions of access challenges that require immediate solutions to forestall any health challenges.

Though the Ghana Health Service has asked victims seeking care to be seen free of charge at other facilities, it is anticipated there may still be challenges to seeking care that require immediate attention. The authorities are requested to ensure that these facilities resume service delivery in good time. Though the team was informed by the District Chief Executive of North Tongu district during the community entry process that there were about six mobile medical teams delivering healthcare services, the situation on the ground was quite different. For instance, at the St. Kizito camp, we came across only two nurses who were also administering vaccines and the expanded programme of immunisation (EPI) schedule to appropriately aged children.

The Richard Novartis Catholic Hospital at Sogakope had suspended healthcare delivery until further notice. This situation arose as a cascading effect of the flooding situation. The electricity substation in the town had been submerged, causing the cessation of the electric power supply. Subsequently, the water company could also not pump/supply water to the town, including the hospital.

Without water to facilitate hand washing, infection prevention and control (IPC) is generally compromised. Fortunately, the district hospital in Sogakope is still providing services. However, it will now have to be accessed at some transportation cost to those who usually accessed service from the Catholic hospital. Additionally, the spillover of Richard Novartis Catholic Hospital patients will likely cause increased workload and pressure in nearby health facilities. The disruption in health services delivery at various levels is likely to take a toll on maternal and child healthcare services, sexual and reproductive services, and the management of non-communicable diseases. This situation needs to be addressed immediately to avert any increased morbidities, mortalities and complications from hypertension, diabetes, and similar chronic conditions.

3.3.2 Water and Sanitation

Availability and access to clean drinking water were limited. All pipes and boreholes in the community were most likely contaminated, and victims were asked not to drink from those sources. Victims had exhausted sachet waters donated to them. The distribution of the water came with challenges, as some victims did not get adequate quantities to meet their needs. Apart from drinking water, access to water to wash clothes and cooking utensils and to bathe was also limited.

Again, we observed that several households were submerged, including the KVIPs and septic tanks. Additionally, the cemetery in Mepe was still submerged. Access to toilets was limited, leading to the victims engaging in open defecation. It is most likely that the stagnant water would be contaminated with household and human waste. The general sanitation situation in the area leaves much to be desired. Though some mobile toilet facilities had been provided, the general observation was that these were woefully inadequate, and some members of the community and campsites confessed that they currently resort to open defecation. The potential for contaminating drinking water sources, water-borne diseases and, specifically, cholera outbreaks remain a clear and present danger for the residents, especially in Mepe and Battor. There were also reports of skin rashes arising from the use of existing water sources, which had seen some form of contamination. Donations have focused on drinking water, but little attention has been paid to water for bathing and cooking. It was noted that some water tank supplies had come in from VRA, but these were said to be inadequate. Authorities should urgently find ways of addressing these hygiene challenges to avert any untoward health outcomes.

Stagnant water collections abound in the Mepe community even as the floods gradually recede. It may take some time for these to completely dry out, and they can serve as breeding sites for mosquitoes, thereby increasing the vector density in the area. There is, therefore, a reasonable potential for increased malaria cases, especially among children under five and pregnant women in the area. Key findings from the WASH are outlined next.

1. **Water Contamination:** Floodwaters have inundated cemeteries and flowed through communities, potentially contaminating water sources, including surface water, hand-dug wells, boreholes, and storage facilities. Effective fumigation and disinfection are urgently needed to prevent potential waterborne epidemics.
2. **Hygiene Practices:** The state of hygiene practices in the affected communities is poor, with limited access to handwashing facilities, soap, and sanitisers. Promoting handwashing with soap (HWWS) through the provision of Tippy Taps and sanitisers is essential to prevent the spread of diseases.
3. **Sanitation Systems:** The septic tanks, latrines, and sewage systems in the communities are submerged, leading to sewage flowing into surface water and wells. Open defecation is also on the rise due to a lack of adequate sanitation facilities.
4. **Mortuary Contamination:** The inundation of a mortuary in Sagakope poses a risk of contaminating both surface and groundwater sources, highlighting the need for immediate action.
5. **Wildlife Displacement:** The floodwaters have brought snakes and other reptiles into communities, resulting in snakebites. The inundated houses have become hiding places for these animals.

6. **Low WASH Awareness:** The awareness levels of the affected communities regarding WASH issues and emergency preparedness are low. Community-based organisations and external entities should assist in disseminating information and supporting recovery efforts.
7. **Potential Water Source Contamination:** There is an elevated risk of water source contamination due to flooding.

3.3.3 Psychological Trauma and Stress

The flood experience, coupled with having to put up in safe camps as displaced persons, and loss of personal property, presents a strenuous environment for the victims and leads to stress, depression and other mental health challenges that could linger on long after the floods. The role of clinical psychologists in providing some counselling/psychosocial interventions to these affected persons is key and must be pursued to alleviate the development of possible post-traumatic stress disorders. It was unclear what or how much had been done in this direction during the reconnaissance visit. Still, we had a report from a member of the team, a clinical psychologist, that the Ghana Psychological Association, in conjunction with an NGO, was planning to offer these services. The team should be given the needed support to undertake this all-important exercise.
A significant component of the disaster effect is mental health distress. Often, this component is least attended to in developing countries. Again, mental health issues are often projected to arise over time following disasters. As such, risk factors such as the nature, severity and duration of the disaster are considered in the projection. Also, individual and community factors are considered. Support and professional mental health or psychosocial attention during and after the disaster becomes a valuable activity to allay fears of future distress. The following observations were made regarding mental health among the victims.

i. They have been displaced for over a month, long enough to trigger posttraumatic distress.
ii. They have lost their homes, farms, and other sources of livelihood.
iii. Concerns of life after the disaster persist in their minds.
iv. There are complaints of fear, sleeplessness, hypersensitivity, and worry among the displaced population.
v. Promiscuity, especially among the youth in the safe havens
vi. No clear mental health attention has been provided to the victims.
vii. Default and relapse among existing mental health service users

There are several coping mechanisms individuals adopt when bedevilled with disasters. This has been shown through communalism and a heightened sense of resilience among the victims.

3.3.4 Feeding and eating situation of vulnerable groups.

They were feeding space for children to breastfeed and to also feed children their complementary foods. These were done within the camps. In Ghana, breastfeeding children do not usually require a special space to do so as open breastfeeding at any place and time is accepted.

3.3.5 Cooking utensils to prepare food.

1. Access to cooking utensils to prepare meals for children and families was limited. Some of the victims indicated that all the utensils that they previously used were washed away by the floods, and they did not have access to them.
2. Access to fuelwood to prepare food was also a challenge.

3.3.6 Availability of foods

1. The victims indicated all their food was washed away by the floods.

2. Food donated by NGOs, benevolent organisations, and NADMO is being distributed to the victims.

3. Except for cereals such as rice and maize that were provided to the victims, none of the following foods were provided.
    - Cereals (milled oats, wheat flour, rice, maize flour) or tubers (Potato, Sweet potato, Yam, Cassava flour, Banana, Plantain
    - Animal-source protein-rich foods (Beef, Pork, Lamb, Goat, Chicken, Egg)
    - Plant-source protein-rich foods Legumes/pulses (Beans, Peas, Lentils, Nuts
    - Green leafy vegetables rich in vitamins and minerals (Spinach, Cassava leaves, Beet leaves, Amaranth leaves)
    - Dark orange or green vegetables rich in vitamins and minerals (Carrots, Pumpkin, Squash, Green peas
    - Fruits rich in vitamins and minerals (Ripe mango, Ripe papaya, Musk melon, Banana, Pear
    - Oil and sugar were provided in some instances, but these were limited.

4. A concerning finding was the availability and distribution of unhealthy foods, such as sugar-sweetened beverages, energy drinks and canned foods (such as canned tomatoes). Given the handy and easy-to-carry nature of these food items, most donors tend to donate these kinds of foods to the flood victims. However, these kinds of food are unhealthy, and their frequent consumption may increase the risk of developing non-communicable diseases such as diabetes.

5. The foods provided were thus less diversified and can generally be described as unhealthy and will not meet the nutritional needs of victims, especially vulnerable groups such as children, infants, pregnant women, and lactating mothers. There is, thus, the risk of malnutrition if the situation is not averted. Malnutrition in children is a critical issue as children require nutrients to ensure the development of their brains and mental capacity.

6. Micronutrient supplementation for pregnant and lactating children was also unavailable at the health centres and/or clinics. Victims indicated that before the floods, micronutrient supplements were not available at the health centres and clinics.

3.3.7 Nutrition Status of Children and Women

Although visible signs of malnutrition were not immediately apparent, keen observation revealed that the children appeared hungry. It is important to acknowledge that malnutrition may be present, manifesting in a slow and chronic manner. This form of malnutrition, while not displaying acute symptoms, can be more perilous than cases with more immediate and visible effects.

Table 2: Nutritional status of five children sampled.

Age (in months)	Gender	Weight (in Kg)	Height (in cm)	WAZ	HAZ	BAZ	MUAC
30	Male	11.4	87.4	-1.31	-1.33	-0.73	14 9
60	Male	15.6	107.2	-1.21	-0.6	-1.35	15
84	Male	21.15	123.4	-0.59	0.32	-1.28	17
48	Male	13.9	97.7	-1.28	-1.34	-0.63	15.4
60	Male	21.75	120.4	1.25	2.25	-0.14	16.5

Table 3: BMI and weight classification of a small sample of women

Age	Gender	Weight (in Kg)	Height (m)	BMI	Classification
55	Female	56.4	1.54	23.8	Normal
61	Female	70.5	1.73	23.6	Normal
40	Male	73.3	1.73	24.5	Normal
70	Female	77.8	1.59	30.8	Obese
32	Female	63.1	1.58	25.3	Overweight

3.3.8 Education

3.3.8. 1 Closure of Schools

The location and plight of the displaced population are the first signposts that attract the attention of the first-time visitor to Mepe. This was evidenced by the safe-haven educational facilities that are dotted in the community. The results from the rapid assessment study indicated that the school facilities at Mepe did not suffer physical inundation from the flood waters. Rather, the school facilities have been designated as a haven that houses the displaced families, thus depriving teachers, and students of access to the facilities for teaching and learning. Interaction with RC Basic and JSS school camp managers revealed that teaching and learning had been suspended for three continuous weeks.

> "*Since we came here almost three weeks ago, the students and their students have not had access to the school. This is because the school is being used as a camp to house some displaced families*" (camp attendant, Mepe RC Primary).

The use of the classroom facilities also presented an environmental management challenge that, from all indications, will have to be addressed if normal teaching and learning activities are to resume. For instance, the compound of the schools visited has been transformed to accommodate

temporary bathrooms, refuse dumps, a kitchen, and a washing area. The challenges associated with these transformations were re-echoed during an interview with a camp assistant at Mepe DA JSS:

> *"As you can see, the women do all the cooking here. At the same time, this is where they cook and do all the household chores they would have originally done in their homes. This cannot facilitate teaching and learning*."

3.3.8.2 Absenteeism

The assessment further revealed that flooding events prevented students and teachers from accessing school facilities due to flooded roads, damaged infrastructure, or safety concerns. A volunteer teacher at the RC JHS indicated that most students and teachers have had to temporarily stop coming to school because the floods cut them off. The disruptions in the regular teaching and learning schedule have led to the loss of contact hours for teaching and learning. As a way of ensuring that students who are least affected by the floods are available to attend classes, some volunteers have organised classes for students, but this is done under trees (see Figure 6).



*Figure 7**: classrooms under Trees***

While this is laudable, the interaction with the volunteer teachers revealed several challenges. For instance, students at the JHS were all put together, irrespective of the level. This affected content delivery and pedagogy application as the volunteers were not trained to oversee multi-level groups as well as students with mixed abilities. A female volunteer who has become the icon of the community due to her selflessness intimated during the interview:

> *"These are students in JHS one to JHS three, and so sometimes when I am teaching a form three topic, the form one and two students find it difficult to understand. Sometimes, some of the students are more brilliant than others, so they tend to control the class. This affects effective teaching and learning*."

Another challenge identified was the many disruptions of the classes under trees due to intense sunshine and heavy rainfall. A male volunteer teacher at RC JHS had this to say:

"There are many instances we have had to suspend classes because of the rain. This is the rainy season, and so the rain falls during the daytime. There are times, too, that we must allow them to go for a long afternoon break because of the intense sunshine that can penetrate the shade. As you can see, the desks are empty because we have asked them to go for a long break."

3.3.8.3 Psychological and emotional impact on students.

The emotional and psychological impact effect of the disaster on students was examined. The participants were unanimous that they constantly live in fear. They were concerned about the fear of the flood occurring again. Others were anxious about the effect the continuous closure of the schools was going to have on their academic achievements. A boy in one of the groups articulated the concerns of the group when he wondered if they were going to catch up for the period of contact hours lost and whether the Ministry of Education was going to give them special dispensation to recover the lost period. Another traumatic experience for the students was the fear of the flood coming again. "We are always afraid when we see the clouds gathering. I always ask my mum whether the flood is coming again." These sentiments were re-echoed in the other FGD. The emotional and psychological impact of experiencing the flood disaster affected students' ability to concentrate and engage in meaningful learning.

3.3.8.4 Destruction of educational materials

Participants' observations, corroborated by key informant interviews, showed that some students had lost valuable education materials, including textbooks (Figure 7).



*Figure 8**: Destroyed Textbooks***

During the interaction with the victims (both students and their families), it emerged that for some of them, the flood took them by surprise, and they could not, therefore, mobilise to safety personal items. A key informant recounted:

"*In the house, we keep the books of the children on the floor, and so when we saw the floods coming, we could not salvage them."*

Another student explained how she lost her books to the floods:

> *"That day, the lights went out in the whole community. Our room was dark, so when we asked to pick up our things, I forgot where I had kept some of my books, which is why my English Language textbook got wet. Now what I am doing is to keep them in the sun, hoping it can dry so I will use them again."*

These experiences have significantly affected teaching and learning at Mepe.

3.3.9 Limnological and Toxicology

Table 4. Water Quality Parameters, Nutrients, and Heavy Metal Concentrations. Data presented in bold print exceed Ghana and WHO standards for drinking water.

PARAMETERS	MEPE 1 Flood Water	MEPE 2 Flooded Borehole	MEPE 3 Borehole	MEPE 4 Volta River	FIELD BLANK	GHANA STANDARDS /WHO LIMIT
Physical test						
Temp °C	32.73	29	29.3	29.4	25.8	25
pH	6.9	6.15	6.49	6.45	8.12	6.5-8.5
Conductivity (µ/Scm)	325	246	**1856**	84	0.4	<700
Total dissolved solids (mg/l)	142	123	927	42	<0.1	1000
Turbidity (NTU)	**215**	3.37	7.51	**5.34**	0.44	5
Dissolved Oxygen (mg/l)	**3.46**	**2.45**	**3.64**	5.79	6.8	5
Nutrients test						
Nitrate nitrogen (mg/l)	1.2	0.7	1.5	0.8	0.6	10
Phosphate (mg/l)	**0.79**	**0.12**	**0.21**	0.02	<0.01	0.03
Ammonia Nitrogen (mg/l)	**0.54**	0.47	0.03	0.01	<0.01	0.5
Sulphate (mg/l)	23.2	11.2	71.4	4.1	<0.1	250
Nitrite Nitrogen (mg/l)	0.002	0.002	0.043	0.004	<0.001	0.1
Heavy/Trace metals test						
Lead (mg/l)	**0.03**	**0.04**	0.01	<0.01	<0.01	0.01
Iron (mg/l)	**3.33**	**0.47**	0.29	0.06	0.06	0.3
Cadmium (mg/l)	**0.03**	**0.01**	**0.04**	**0.02**	0.001	0.003
Copper (mg/l)	0.01	0.01	0.01	0.01	<0.01	2
Chromium (mg/l)	**0.04**	**0.04**	0.01	**0.02**	<0.01	0.01
Arsenic (mg/l)	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.01
Mercury (mg/l)	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.001
Bacteriological Test						
Feacal coliform (cfu/ml)	**2750**	**450**	**550**	**250**	0	0 [10*]
Total Coliform (cfu/ml)	**7150**	**8500**	**3150**	**3750**	0	0 [400**]

/ standard in parenthesis is for coliform counts in treated effluent from sewage treatment plants.*

Table 4 presents general water quality parameters, nutrient concentrations, and heavy metal concentrations. Ghana and World Health Organization standards are indicated in the last column of the table. Measured values exceeding standards are indicated in **bold** print. For coliform counts, both drinking water and treated effluent standards are given for context.

Exceedances are noted for all environmental samples. However, parameters are especially dire for the stagnant water sample and the nearby borehole, which was flooded (overtopped) during the peak of the flood. Consequently, the composition of the water in this borehole closely resembles that of the stagnant water. Samples taken from the borehole not directly inundated by the floodwaters had less and lower exceedances. However, the water quality is still poor and unfit for use as potable water.

These findings suggest that the flood waters caused substantial contamination of the aquifer in the town of Mepe, with the geographic extent of the contamination currently unknown and in need of further study.

3.3.9.1 Implications of Findings Regarding Water Quality

Stagnant water in the towns of Mepe and Battor poses an immediate health risk due to the high coliform counts that may lead to infections or even minor wounds. Furthermore, accidental contact of stagnant water with the mucus membranes of the eyes, nose, and mouth can lead to infections. This is compounded by the fact that some of our previous work on the Lower Volta indicates the presence of antibiotic-resistant bacteria linked to the operation of pen and cage aquaculture in the Volta River. Ingestion of water will likely result in diarrhoea and other digestive tract diseases.

Likely, mosquito populations will rapidly expand as the warm, stagnant water provides an ideal breeding place for these animals. Mosquito-borne diseases are, therefore, an additional concern. During the sampling, private individuals' efforts to spray affected areas were already observed. Fumigation will likely expand in the coming weeks. The quantum and type of chemicals used for this ‘fumigation’ exercise must be closely monitored to avoid secondary exposure by the local population.

As chickens were observed feeding on aquatic invertebrates in nutrient-rich, stagnant pools, fumigation may result in the uptake of pesticides by chickens. Chicken meat, and especially chicken eggs, may become a route of pesticide exposure for the local population as an indirect effect of flooding, stagnant water, and fumigation efforts.

Beyond the immediate health risks associated with the pools of stagnant water in the towns of Mepe and Battor (and likely other towns in the flood-affected area), high metal and coliform counts measured in the two boreholes are worrisome. The similarities in water quality parameters between the stagnant water (#1) and the nearby borehole (#2) suggest that flood water poured into the borehole during the peak of the flood, causing an immediate contamination of the shallow aquifer with pollutants and bacteria. High coliform counts in the borehole not flooded (#3) suggest that contamination has travelled along the aquifer, potentially endangering a much larger population than the geographic extent of the actual flood waters would suggest. Currently, the geographic extent of this contamination and the time to recovery for the aquifer are unknown and require urgent study.

3.3.10 Environmental and infrastructural challenges

There exist two (2) main low-lying areas (valleys) in the Mepe community. These areas are all on the southern part of the Volta River. The valley closer to the Volta River is relatively higher in elevation and smaller in span or width compared with the other valleys. It lies between the Volta River and the main tarred road from Battor to Aklakbanu. The inhabitants generally use this valley as waste dumping sites in different sections along its trench. The second valley is much farther away southwards from the main road. This valley is much wider in span or width and generally has a much lower elevation and greater extent. Within this valley are heavily built residential buildings, which are constructed without layout plans and improperly demarcated road networks, as well as basic schools on its fringes. At Atimpoku, a young man lost his two-bedroom house resulting from a prolonged flooding of about a week. Also, an elderly woman's house was on the verge of collapse as visible cracks running from the foundation into the roof were observed. At Sogakope, many structures including the Comboni hospital and homes were evacuated because the structures had been compromised. Roads and bridges have been submerged and weakened. At Mepe, many houses that got submerged when the spillage began are still not out of the woods.

Concerning waste disposal, there were several waste dumping sites along the trench of the water filled valley . Furthermore, a community cemetery is located at the intersection between the two (2) valleys around an area called Dogorme (Fig. 9).



Figure 9: The intersection between the two (2) valleys at Dogorme.

All these sites have contributed to different dimensions and levels of pollution in the flood waters during the inundation. The flood waters in these valleys that host the waste dumping sites and cemeteries have become heavily polluted (Fig. 5). This development has resulted in

the generation of bad odour in the flood waters that also serve as breeding sites for mosquitoes. These polluted flood waters have completely affected both surface and groundwater sources.



Figure 10: Inundated waste dumping sites, road networks, paths, and cemeteries.

Regarding erosion, an exceedingly high degree of erosion was observed at riverbanks and where communities had been flooded fully, negatively impacting the foundations of buildings. Some electric poles and trees had fallen due to the degree of the erosion. While looking forward for extensive geological assessment, there was visibility of subsidence at Mepe where the water has continuously failed to recede after many weeks.

3.3.11 Geohazard-Geotechnical

Erosion Assessment

A high degree of erosion is evident along riverbanks and in fully invaded communities, resulting in considerable damage to building foundations. Notably, the erosion has caused the collapse of buildings, including electric poles and trees falling due to its severity.

Infrastructure Assessment

In Atimpoku, a two-bedroom house was lost during a week-long flooding event, and an elderly woman's house is on the brink of collapse with visible cracks from the foundation to the roof. At Sogakope, structures, including the Comboni hospital and homes, have been evacuated due to compromised integrity. Roads and bridges in the area have been submerged and weakened. In Mepe, many houses remain at risk, having been submerged during the spillage.

Land Subsidence

Although further geological assessments are advisable for confirmation, subsidence is visibly occurring, particularly in Mepe, where water has not receded after several weeks. These observations, when considered alongside historical incidents related to Akosombo Dam-controlled water spillage and other flooding geohazards in the region.

A future investigation should focus on:

- Cracks in the Ground: Identifying visible cracks or fissures in the ground, pavement, or structures, indicating subsidence patterns.
- Sinking or Tilting Structures: Monitoring buildings, roads, bridges, and other structures for uneven sinking or tilting, which can lead to structural damage.
- Changes in Ground Level: Using surveying and geodetic techniques to measure reductions in ground level over time, assessing the rate of subsidence.
- Land Sloping or Slanting: Recognizing the development of noticeable slopes in once-level land, impacting water drainage and structural stability.
- Changes in Water Levels: Monitoring the impact of subsidence on water bodies, which can affect water supply and aquatic ecosystems.
- Saltwater Intrusion: Addressing potential saltwater intrusion into freshwater aquifers in coastal areas, impacting drinking water quality.

4. 0 Conclusion and Recommendations

4. 1 Conclusion

The findings demonstrate the need to conduct an extensive longitudinal study covering all flood-affected communities, including those from Buipe and Yapei in northern Ghana, to elucidate these findings and generate a comprehensive report of the situation for an informed response and policy decision. While at it, this rapid assessment demonstrates a challenging and serious emergency and looming risk to health, education, water quality, sanitation, and mental health. The findings underscore inadequacies and inefficiencies of emergency response systems and strategies in the country making it pertinent for improved early warning systems to enhance flood resilience and further shed light on how the fundamental policies underpinning disaster risk reduction were nonexciting or, in some cases, overlooked.

4.2 Recommendations

Recommendations are provided in two-fold. The first fold of the recommendations is directed to UTAG, which mandated the execution of this rapid assessment. The second fold goes to all respective government agencies, NGOs, and other key stakeholders.

4.2.1. Key recommendations to UTAG

- UTAG should organise an event for the launch of this rapid assessment report to all government agencies, international development agencies, non-governmental organisations, and other key actors and stakeholders to disseminate the initial findings and, at the same time, advocate for funding and support to launch an extensive longitudinal assessment of the impact of floods in flood-prone communities across the country. The event will serve as a platform to begin conversations and discussions regarding flood impacts and how to have effective response strategies that are evidenced-based and contextually relevant.

- UTAG call on all relevant key stakeholders and research funding agencies to provide the requisite funding to allow for the proposed extensive longitudinal assessment of the impact of flood, flood risk assessment (including mapping using GIS and creation of flood hazard maps and vulnerability maps), habitation of settlers along rive banks, assessment of geological and hydrological conditions, soil liquefaction tests, test of strength of structures, emergency responsiveness, mitigation and resilience strategies and mechanisms.

- Immediately, UTAG should play a key role in promoting and creating an enabling environment for effective teaching and learning in the affected communities. This can be done by the commitment of some funds from the donations that are coming from across its campuses into buying teaching and learning materials for school children, support in paying school fees, especially for those in the tertiary institutions, and finally, collaborating with Vice Chancellors Ghana to consider waiving or discounted the fees of students coming from these affected communities.

4.2.2 Recommendations to other stakeholders

4.2.2.1 Health and nutrition

- NADMO, NGOs and other relevant stakeholders who make food donations to the flood victims should consider diversifying the kinds of foods they provide to meet the nutritional needs of the victims so as not to aggravate the existing poor nutrition situation of under children under five years and other vulnerable groups in the communities.
- The Ghana Health Service in the District should provide basic health screening services.
- Continuous nutrition education on the preparation of healthy and safe foods for young children.
- The health facilities in the area are advised to stock up on malaria rapid diagnostic test kits and medications.
- NADMO, NGOs and other stakeholders should make insecticide-treated mosquito nets (ITNs) available to the victims. ITNs should currently be emphasised among the displaced populations in the safe camps housing thousands of people.
- The Ghana Health Service should provide psychosocial first aid for victims, especially in the safe camps. Measures should also be put in place to provide long-term psychological intervention, which experts should plan and execute. This can only be possible if mental health is prioritised by resourcing the mental health units in the affected districts with personnel and medicines.

4.2.2.2 Education

1. The Ghana Health Service should consider revising the academic calendar of the affected communities. There may also be the need for the teaching and learning hours to be extended to make for the lost contact periods.
2. Teachers and students should also benefit from psycho-social support or counselling. This will relieve them of the stress and anxiety they are currently experiencing.
3. While the distribution of relief items is important for response and recovery, specific education items like textbooks, exercise books and other teaching and learning materials should be distributed with urgency so teaching and learning do not suffer.
4. Overall, early warning sign mechanisms should be re-emphasized. Such an approach should be an integrated one and should involve the community members. early warning strategies should include students and teachers. This can help such an activity get the needed traction it deserves. It is through this that the effects of future disasters can be minimised.

4.2.2.3 Water Quality

- Contact with stagnant flood waters needs to be avoided, especially by children who are playing and swimming in what is effectively a soup of raw sewage mixed with leachates from solid waste dumps.
- Borehole and well water in Mepe and the surrounding area are not safe for human consumption and should not be used until they are certified as safe.
- Though the water in the rivers seems clear, the level of turbidity is much higher than in pre-flood conditions and is still not safe.

- Levels of Cadmium in the water samples suggest that there is poor disposal of batteries in the area, and education on waste management must highlight the need for proper disposal of material that can lead to heavy metal contamination.
- Emergency water filtration systems are urgently needed to address the needs of the population.
- The geographic extent of aquifer contamination needs to be established as soon as possible.
- Vigilance to treat even minor infections in the population with antibiotic ointment is required.
- Fumigation efforts need to be carefully controlled and followed by best management practices.
- Local chicken eggs and meat should be avoided until pesticide concentrations can be measured in these products.
- Aquifers will require repeated testing over several months to assess when and if water quality parameters allow for the consumption of these waters.
- Safe Havens must be sited at locations that will not require boats to access in times of floods to reduce contact with contaminated water.

4.2.2.4 WASH

- **Immediate Water Quality Management:** NADMO should collaborate with relevant government agencies, local authorities, NGOs, and CSOs to implement a comprehensive water quality management programme that includes fumigation, disinfection, and water quality testing of all water sources. Distribute safe drinking water or water purification tablets to the affected communities.
- **Promotion of Hygiene Practices:** There is a need to launch a WASH sensitisation and education campaign, emphasising the importance of HWWS, proper hygiene behaviour, and the availability of hygiene supplies (soap and sanitisers). Distribute hand sanitisers, provide Tippy Taps, promote their immediate construction using local materials, and encourage regular handwashing.
- **Sanitation Solutions:** NADMO should collaborate with relevant government agencies, local authorities, NGOs, and CSOs to establish more temporary sanitation facilities, particularly more mobile latrines, to address the immediate needs of displaced inhabitants. This should include developing a plan for the rehabilitation of sewage systems and sanitation facilities.
- **Mortuary Cleanup:** NADMO should collaborate with local authorities to conduct immediate cleanup and disinfection of the inundated mortuary to prevent water source contamination.
- **Wildlife Management:** NADMO should collaborate with local authorities to manage and remove snakes from affected areas, ensuring the safety of residents.
- **Community Engagement:** NADMO should engage with community-based organisations and external entities to provide information, support, and resources to affected communities. This should include developing and disseminating educational materials on WASH and emergency preparedness.
- **Water Source Protection:** NADMO should collaborate with local authorities to implement measures to prevent further water source contamination, such as restricting access to affected areas and implementing buffer zones around water sources.

4.2.2.4 Monitoring and Follow-Up for Improving WASH

To track the progress of interventions, ensure sustainability, and respond to emerging WASH issues post-assessment, the following actions should be taken:

- **Establish a WASH Task Force:** The government, through NADMO, should create a multi-stakeholder task force, including representatives from relevant government agencies, local authorities, NGOs, and community leaders, to oversee the implementation of the recommended actions.
- **Regular Monitoring:** NADMO should collaborate with local authorities to conduct regular monitoring and evaluation of the implemented interventions to assess their effectiveness and address any issues or challenges that arise.
- **Data Collection:** NADMO should collaborate with local authorities to continue data collection on WASH conditions in the affected communities to assess long-term improvements and identify any emerging issues.
- **Community Involvement:** The affected communities need to be involved in decision-making, implementation, and monitoring processes to ensure that interventions are tailored to their needs and preferences.
- **Emergency Response Plan:** NADMO should collaborate with local authorities to develop and communicate an emergency response plan to address any future disasters or incidents that may affect WASH conditions in the area.
- **Reporting and Documentation:** NADMO should collaborate with local authorities to maintain records of progress and challenges and provide regular reports to stakeholders, donors, and the public to ensure transparency and accountability.

***4.2.2.5** Flood Risk Assessment*

There is a need for a more detailed hydrological, hydrogeological and flood risk assessment (FRA) of the Lower Volta basin (using Mepe and surrounding communities).

i. Conduct interviews to establish in detail, the flood extent, and its impact on:

   - drinking water availability and quality
   - buildings, road networks as well as environmental sanitation.

ii. Carry out remote sensing analysis to establish the extent of flooding or inundation.

iii. Carry out a hydrological model to assess the water balance and impact of climate change on the hydrologic response of the Volta basin (Upstream and Downstream)

iv. Carry out hydraulics modeling to simulate different scenarios of spillage and the corresponding flood inundation/extent downstream.

v. Develop a flood prediction model using different scenarios of spillage from VRA.

5.0 References

Arneson, M. (2022). The Twisted Logic of Remote Work: A Qualitative Study on employees' perceptions and experiences of working Remote in the presence of COVID-19.

Grasley-Boy, N. M., Gage, N. A., Lombardo, M., Anderson, L., & Rila, A. (2022). School-Wide Positive Behavior Interventions and Supports in Rural and Urban California Schools: Effects on Fidelity of Implementation and Suspension Outcomes. *Rural Special Education Quarterly*, *41*(2), 84-94.

GSS (Ghana Statistical Service). (2012). *Final report on population and housing census*. Accra: Sakoa Press.

Owusu-Sekyere, E., Yakubu, A, R. and Wedam, E. (2017). The Central Medical Store Fire Disaster: A Test for Institutional Compliance in Disaster Prevention in Ghana, *SAGE Open*. 1-11