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Assessment of Hazard Flash Points Predisposing Resident Communities to Disaster Risk in Adentan Municipality in Ghana

Stephen Twumasi Annan^{1,*}, Francis Adarkwah², Memuna M. Mattah³, Stephen Awuni⁴

¹Department of Science, SDA College of Education, P. O. Box 18, Asokore-Koforidua

²Vision World Network Ghana, P. O. Box DK 74, Darkuman- Accra

³Department of Environment and Development Studies, Central University, P.O. Box 2325 Ghana

⁴Science and Technology Policy Research Institute (CSIR-STEPRI), P. O. Box CT 519, Cantonment, Accra-Ghana

*Corresponding author: stwumasiannan@yahoo.com

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Abstract The dynamics in global development and population growth has led to increasing disasters. Migration to urban areas in the quest for greener pastures and white colour jobs in developing countries has become a driving force of movement of people. This has led to high demand for land in urban areas compelling many urban poor to reside in slums and waterways. This exposes the urban poor to many hazards resulting in disaster occurrences. Ghana is not an exception to this phenomenon. The situation in Ghana is further exacerbated by the complexities of the land tenure system. This study was therefore conducted to assess the current hazards that predispose communities in the Adentan municipality to vulnerability and possible disasters, and to inform decision making. Stratified random sampling was used to sample respondents for focus group discussions, interviews, and questionnaire administration. A global positioning system (GPS) was used to pick coordinates of flashpoints of hazards and disasters prone areas, and field observations were also used to complement available data. Hazards such as uncompleted roads and drainage systems, encroachment on wetlands and waterways were identified to be the major causes of the recurrent flooding in the area. Improper wiring and bad practices were found to be the cause of fire outbreaks. Lack of enforcement of Land use and Spatial Planning Act 2016, building regulations, poverty, urbanization and decline in ecosystem services contributed to disasters. Principles of green economy, proper law enforcement for planning and building regulations were recommended to ensure sanity in the municipality.

Keywords: disaster, risk; hazards, vulnerability, Adendan municipality, environment, Ghana

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1. Introduction

Disaster is the inability of a society or communities to cope with their own resources, as serious interruptions impact on the proper functioning of either human, economic, material or social life causing losses [1]. Current development dynamics and demographic changes, therefore, put more people at risk of disasters across the globe which Ghana is not an exception. Contributing factors include climate change, increasing poverty, rapid urbanization, the growth of informal urban and coastal neighbourhood, poor urban governance, and declining ecosystem services. This situation is exacerbated in Ghana by the fact that, it is situated in one of the world's most complex climate change regions, affected by tropical storms and the climatic influence of the Sahel and oceans, which exposes the country to floods and droughts [2]. The

country, therefore, stands the risks of landslides, urban and coastal hazards such as fire outbreaks, storms, floods, and coastal erosion.

The catastrophic floods in the three regions of Northern Ghana in 2007 affected more than 300,000 people with close to 100,000 requiring assistance in various form to restore their livelihoods. Direct emergency funding for the devastation was US\$25.1m. Property loss from floods in the Southern part of Ghana in 2009, June and July alone, amounted to about US\$ 5,813,954.7 and a death toll of 23 [3]. The recurring floods in 1999, 2001, 2008, 2009, 2010 in the country and the 2015 floods in Accra which resulted in the June 3rd disaster, leading to the loss of several lives and property confirms the country's vulnerability. To further reveal the vulnerability situation is the gas explosion at Atomic junction on October, 8th 2017, whereby 6 people lost their lives.

Disaster Risk Reduction is gradually becoming one of the key priorities of the government, and there has been

obvious progress. In this regards, Government’s first strategic goal to the Hyogo Framework is to integrate Disaster Risk Reduction in Sustainable Development policies and planning. It has also instituted and strengthened the National Disaster Management Organization (NADMO) in order to define a roadmap for Disaster Risk Reduction. The focus, however, has rather been on emergency response rather than risk reduction influenced by policy and practice. The perennial flooding in the country causing disasters have been attributed to both natural and anthropogenic factors [4]. Other leading factors include lack of coordination among various sectors, siting of illegal structures, undersized hydraulic structures due to population increase, designing problems, rapid changes in land use patterns due to urbanization, development of settlement in watercourses and floodplains has contributed to flooding [5]. The problem is further compounded by the complex nature of the land tenure system in the country which turns to hinder the government’s efforts to address disaster issues in the country. The agriculture and the service sectors which contribute over 50% of Ghana’s gross domestic product are the most affected [3].

The situation in Adentan Municipality Assembly is not different as the municipality is seen to be confronted with several challenges such as flooding, waste management, contaminations of the environment from improper disposal of both solid and liquid waste, disease outbreaks and land degradation among other problems. It is against this background that, this study was conducted to explore the current situation on hazards that predispose

communities to vulnerability and possible disasters to inform the decision-making process in the Assembly.

1.1. Study Area

The Adentan Municipality lies 10 kilometers to the North-east of Accra, specifically located on latitude 5° 43’ North and longitude 0° 09’ West. The Municipality has a land of about 123sq. km. It shares boundaries with Kpong-Katamanso and Ashaiman Municipalities in the East, GA East-Madina in the West, Kpone-Katamanso in the North and Teshie- Ledzokuku Krowor Municipalities in the south. The municipality serves as a nodal point where the main Accra/ Aburi/ Koforidua and Accra/Dodowa trunk roads pass (Figure 1). The Municipal Assembly was created by a legislative instrument (LI 1888) in 2008. Hither-to, Adentan was part of the then Tema Municipal Assembly which is now Tema Metropolitan Assembly. It has a population of 78,215 with about 74.1 percent of economically age group of 15 years and above, while 25.9 percent are not economically active. Among the economically active population, 91.2 percent are employed while 8.8 percent unemployed. Among the employed population, 31.8 percent are within the service and sales work and 25.4 percent in Craft and related trades. Other economic activities include agriculture such as poultry, livestock, and vegetable production. The population of the district depicts a broad base population pyramid with the youth constitute the broader base [6].

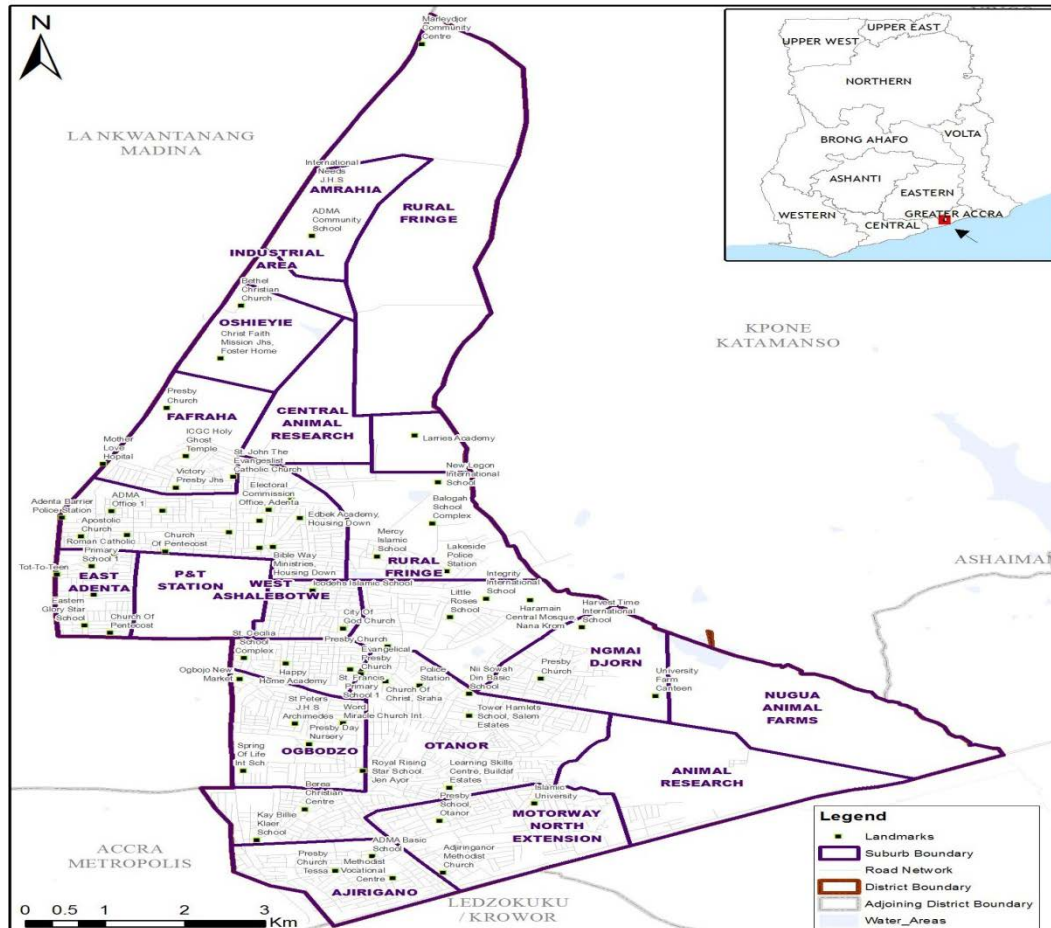


Figure 1. Geographical Map of Adentan Municipality

2. Methodology

2.1. Data Collection

Both secondary and primary data were collected for the study. Secondary data were gathered from published and unpublished reports from the Adentan Municipality and other relevant Local and International Organizations as well as scientific peer-reviewed articles relevant to the study. Primary data were mainly gathered using two main approaches. Firstly, through the use of Geographical Position System (GPS), coordinates were picked on flashpoints of hazards in the Municipality to inform possible hazard flash points map. Lastly, through participatory approach, stakeholder consultations were held. Direct field observations were made at all the four zonal councils, namely; Koose, Sutruna, Gbentaana and Nii Ashaley to generate a matrix and assign weight and levels of risk associated with the hazards identified. Structured questionnaires and interview guides were used. These were pre-tested for reliability and accuracy.

The participatory approaches engaged include Focus Group Discussion (FGD's) and in-depth interviews. The FGD's were held for both the resident communities and staff of NADMO at each of the zonal councils. In all, two FGD's were conducted in each of the zones, totaling eight. The in-depth interviews were conducted with directors and heads of some selected units at the Assembly, which included the head of Planning Unit, officials of Works Department, head of Sanitation and Health Unit and NADMO Director. Further interviews were conducted with selected opinion leaders at the aforementioned zonal councils for their in-depth knowledge about the history of the area as far as disaster is a concern.

2.2. Data Analysis

Risk characterization was done using a matrix and weightings assigned to demonstrate the severity of the hazards. Elements at risk in the study area were assessed based on Political, Economic, Social, Technological, Legal and Environment. These impacts on livelihoods were measured as either low, medium or high.

3. Results and Discussions

3.1. The Political Administration of Adentan Municipal Assembly (AdMA)

AdMA has four zonal councils with twelve (12) electoral areas as presented in [Table 1](#).

3.2. Characteristics of Respondents

In all, eight FGD's were held to solicit information. The Community members were purposively selected based on the fact that, they had lived in the place between ten (10) to (20) twenty years, had experienced some level of impacts of the hazards on their livelihoods and willing to participate in the discussion. The staffs who participated in the FGD's were those working at the various zones

under NADMO directorate because of their particular roles in disaster management in the municipality. Personnel interviewed at the Municipal Assembly were senior staffs. Opinion leaders across all the four zonal councils were also interviewed.

3.2.1. Zonal Councils and Electoral areas in the Municipality

The Municipal assembly consisted of four zonal councils. These are: Sutruna, Nii Asheley, Gbentanaa and Koose zonal councils

3.3. Assessment of Hazards and Vulnerability of the Communities in the Municipality Were Done Using Risk Assessment Matrix

About twelve (12) hazards indicators were identified during the FGD's and interviews conducted using direct matrix ranking ([Table 1](#)). The risks were categorized under Environmental, Economic, Social or political reasons. The risk identified to be associated with the hazards included flooding, breeding of mosquitoes, disease outbreaks, loss of property and in some cases, death. Hazards associated with encroachment and road network were rated to be serious based on their severity while the flood was termed major, meaning the ability to cause a total service failure. The risk associated with floods was also rated very high on residents, property, flora, and fauna. Impact on livelihoods among all the hazards was however rated low because of the coping strategies adopted by resident communities over the years. [Table 2](#), gives detail about the interpretation of the hazards identified during the study.

3.3.1. Map of Potential Flash Point in the Municipality

[Figure 2](#) and [Figure 3](#) shows the potential hazards over a decade. The major potential hazard flashpoints in the municipality were identified to be the numerous wetlands and or dams dotted across the municipality. Other obvious points identified and mapped were the light industrial areas and the flying zone both at Sutruna Zonal Council.

[Figure 4](#) depicts proximity analysis on encroachment within the 100 and 150 buffer zone demarcations. This means that it is expected that within a radius of 100-150 meters' buffer zone, there should not be any human interaction. But the situation looks different as residential buildings have taken up the wetlands, by reducing its size. This situation predisposes other residents to high risk, especially during the peak rainy season. Exacerbating the situation is the geographical location of the entire Municipality. The study revealed that Adentan Municipality lies below the Akuapem Ridge; therefore, anytime it rains at the Akuapem Ridge, residents at Adentan are subjected to high risk. Thus, even in the absence of rains in the Municipality, residents in Adentan continue to fall victim to disaster risk. This demonstrates that the entire residents of Adentan are vulnerable to flood. This justifies the need for the Municipality to enforce their land use plan to ensure that wetlands/dams across the entire Municipality serve it natural ecosystem services to reduce

their level of risk to flood. Figure 2 shows the level of built-up environment as of 2006 compared to 2016. In 2006, one could see a high level of vegetation cover and dispersed nature of residential buildings and how far there were from the wetlands. In 2016, the

situation looks different as vegetation's seems to be disappearing and residential apartments/ built-up environment catching-up with the wetlands. This shows the level of encroachment and the risk residents are exposing themselves to.

Table 1. Zonal Council of Adentan Municipality

Zonal Councils	Electoral Areas	Communities
Koose	Koose	Marlejo, Ashieye, Amrahia, Amanfro and Ampoman Village
Gbentaana	Gbentaana	Adentan old town, New Adentan, Adentan housing estate, Approtech, Commandos. New Legon, East Adentan, SNNIT Flats, Frafraha, Ritz areas, Alhaji.
Nii Ashaley	Nii Ashaley	Ashaley Botwe, Ogojo, Sraha, Little roses, Japan Motors-Lake side, Third gate, Agrap Adjei, Part Dzen Ayor.
Sutrunaa		Obudankandi, University farm, Nmai Djorn, Otano, Dzornaman, Trassaco Area, Adjiringanor, Bedzen, Tersa, Otinshie and Part Ayor.

Table 2. Risk Assessment Matrix

Hazard	Risk Category ¹	Risk	Severity ²	What is at risk	Risk Rating ³	Impact on livelihood
Encroachment on wetlands and water ways	Environ>Direct Social>Direct Econ>Direct	Flooding, breeding of mosquitoes, biodiversity, microclimate, and loss of properties	Serious	All residents and properties	High	2
Flood	Environ>Direct Social>Direct Econ>Direct	Diseases, loss of property, death	Major	Residents, property, flora and fauna.	Very High	2
Fire outbreak	Social>Direct Econ>Direct Environ>Indirect	Loss of property, death, injuries	Significant	Residents, property, fire service personnel	medium	1
Road Network	Political>Direct Econ>Direct Social>Direct	Vehicular accidents, air pollutions from dust, contamination of food & respiratory diseases	Serious	Households, general public, motorist, pedestrians	High	2
Quarry sites	Environ>Direct Social>Direct Econ> Direct Political>Direct	injury, death and damage to properties, pollution	Significant	All staffs, visitor and residents, fire service personnel and properties	High	1
Irrigation	Environ>Indirect Econ>Direct Social>Direct Policical>Direct	Vegetable contamination, disease outbreak, food poisoning	Significant	Consumers	Medium	1
Drainage system	Environ>Direct Econ>Indirect Social>Indirect	Diseases outbreak, sanitation	Significant	Residents	Medium	1
Sanitation	Environ>Direct Social>Direct Econ> Direct	Disease outbreak, pollution,	Serious	Residents, Assembly	High	2
Wiring	Environ>Direct Social>Direct Econ> Direct	Fire outbreak, Death, injury, loss of property	Significant	Residents, Fauna and flora	Medium	1
Siting of telecommunication mast	Environ>indirect Social>Direct Econ> Direct	Radiation exposure, Noise	Minor	Residents	Low	1
Footbridges	Environ>indirect Social>Direct Econ> indirect	Injury, Death	Minor	Residents	Low	1
Siting of gas filling station	Environ>indirect Social>Direct Econ> Direct	Injury, death, loss of properties	Minor	Residents	Low	1

Source: Adopted from GSS, (2010).

¹ Political , Economic (Econ), Social , Technological (Tech), Legal, and Environmental (Environ)

² *Major* - Total service failure; *Serious*- Short-term total service failure; *Significant*- Short-term partial failure; *Minor*- An annoyance that does not disrupt service provision

³ *Low*= 1-5; *Medium* = 6-10; *High* =11-15, *Very high*= 16-20

4. Impact on livelihood: likely = 1 Very likely=2 Not likely=3

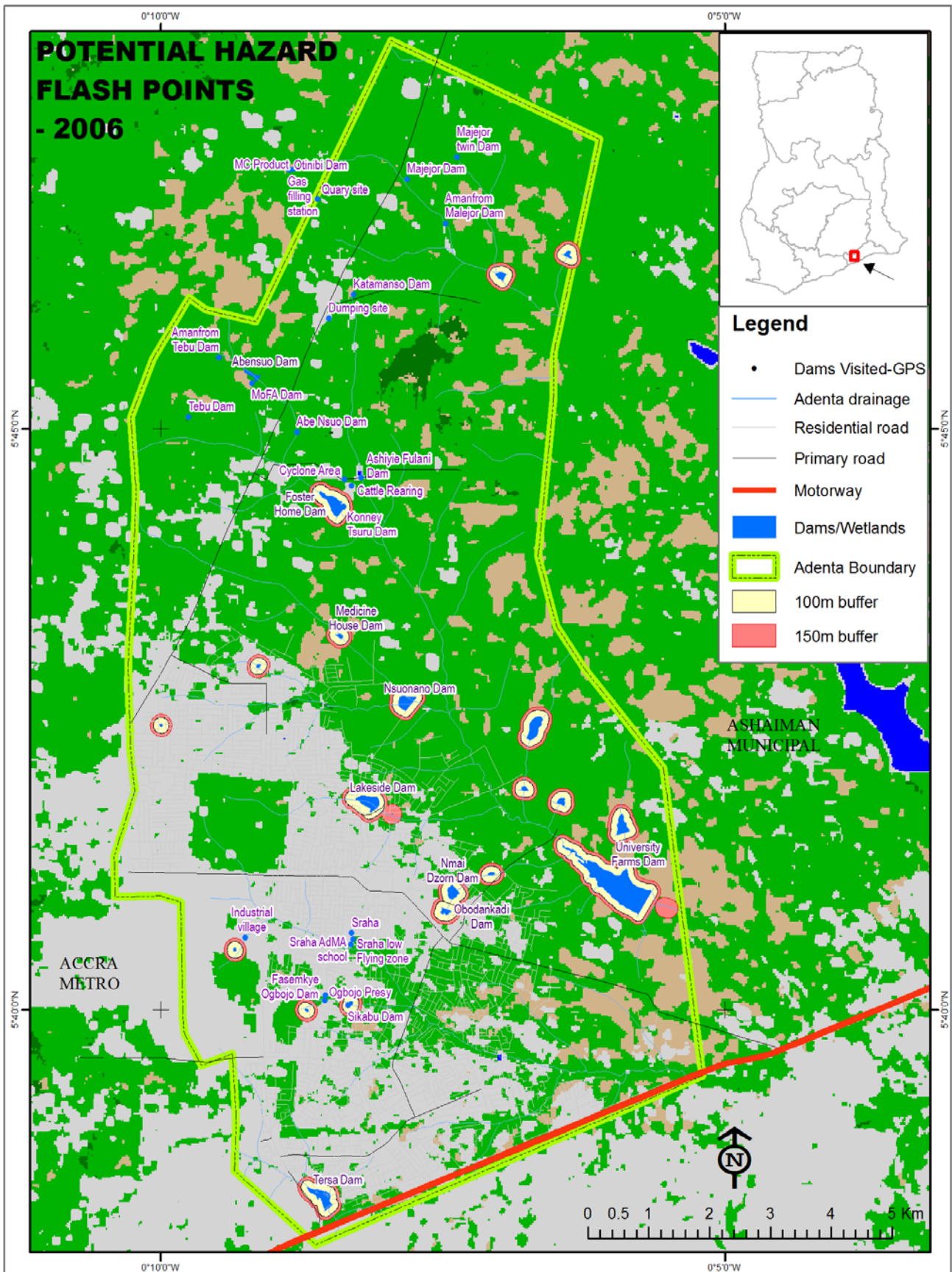


Figure 2. Potential Hazard Flash Points at the study area as at 2006

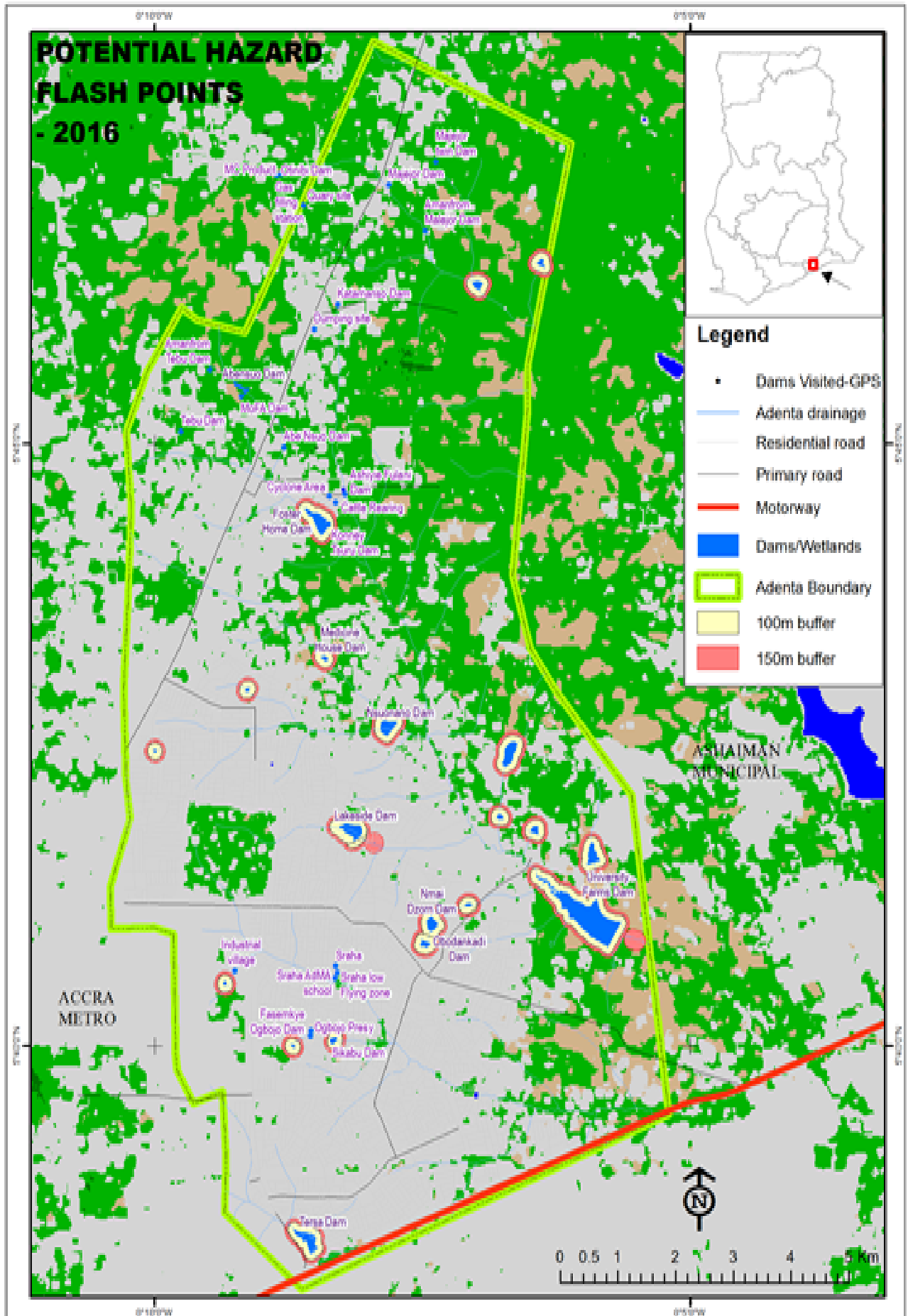


Figure 3. Potential Hazard Flash Points at the study area as at 2016

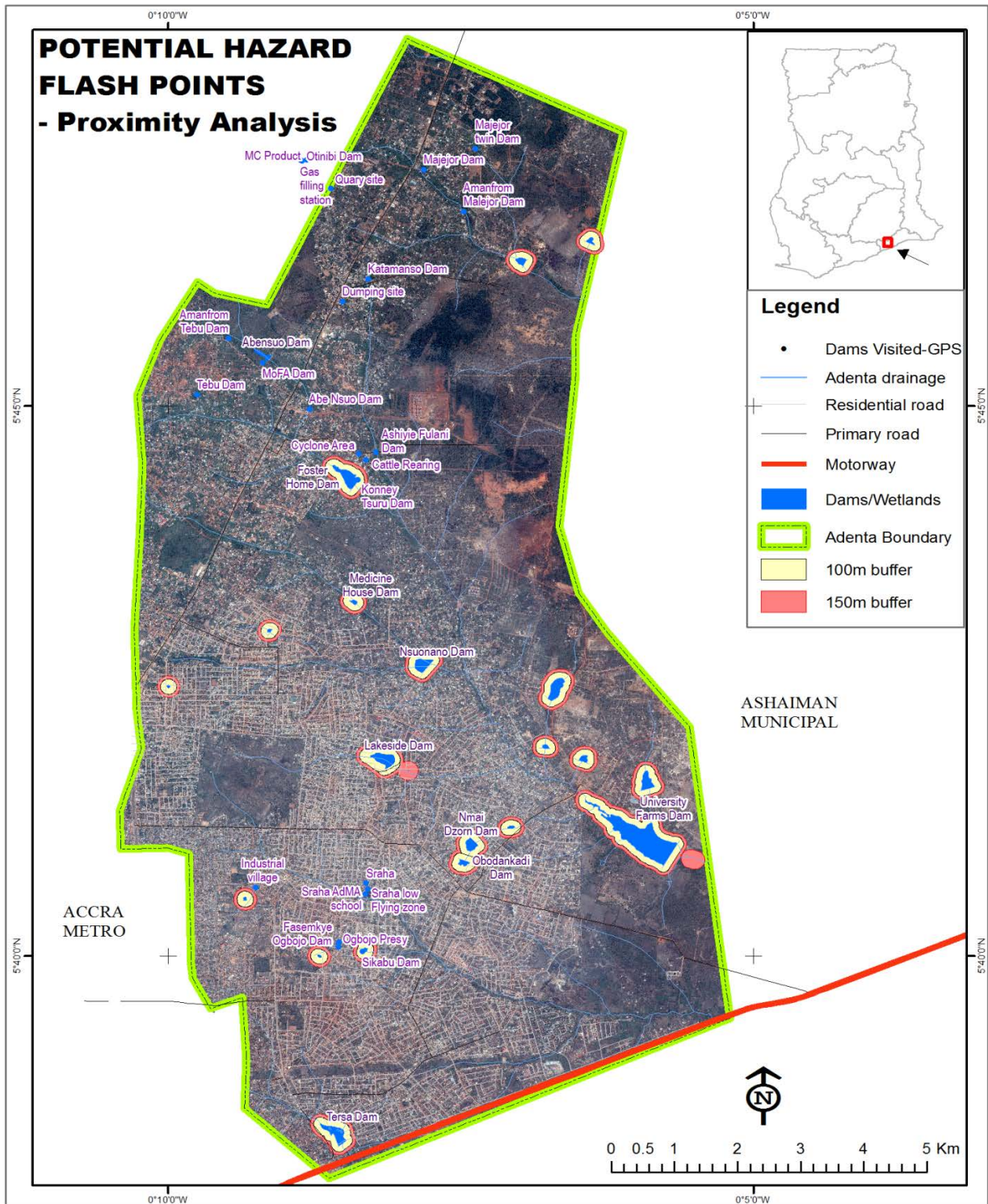


Figure 4. Encroachment within buffer zone at Adentan Municipality

3.4. Discussions

3.4.1. Approach for identifying Hazard in the Municipality

The study adopted the Disaster Crunch Model to illustrate how hazards and vulnerability could combine to cause disaster among a population. This model is useful for understanding that, disaster happens only when hazards affect the vulnerable population [5].



The terms considered in this study are,

Disaster is defined as the inability of a society or communities to cope with their own resources serious interruptions that impact on the proper functioning of either human, economic, material or social life causing losses.

Hazards are extreme events or occurrences, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

Vulnerability is a characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard.

Risk

Livelihood is a ways people combine their capabilities, skills and knowledge with resources at their disposal to enable them to make a living.

Source [6].

Major hazards identified in the Municipality

3.4.2. Encroachment on Wetlands

The Municipality is endowed with lakes, dams, and ponds as shown in [Figure 2](#) and [Figure 3](#). The phenomenon of encroachment on wetlands was observed to be a hazard across all the four zonal councils [Figure 4](#). This practice has a direct impact on the environment due to the loss of the ecosystem services that these wetlands are to provide. Socially, it affects their livelihoods causing residents to be vulnerable to floods, mosquitoes and in some cases loss of properties. This hazard was, therefore, rated serious because its resultant effects could cause short-term service failure. Residents, however, rated the impact on livelihood as low because of the adaptive measures such as filling their surroundings with laterites to raise the level of their foundations, evacuating to safety before rains and improvised means during rains such as standing on tables or higher grounds together with their valuables.

Floods: Floods were rated as a hazard which had direct causes from the environment, society and economic activities ([Table 1](#)). It had the potential to cause short-term total service failure by denying residents access to their homes, farms, disruption in energy and water supply, total destruction of properties and even sometimes injury or death. This was evident during the 2015 flooding in Accra including Adentan and some other parts of the country. Although all the four zonal councils in the Municipality were affected by floods at the time of the study, the most affected areas observed were Koose electoral area, Amrahia, and Malejor. Around Malejor area, according to a resident interviewed and from observations, the area sometimes becomes flooded even without experiencing rains. It is stated that when it rains upstream from the Akwapem range (Aburi and its surroundings) it causes flooding at the receiving end which is the study area. This has placed the residents in a very vulnerable state and high chances of experiencing disasters.

Wiring and Fire outbreaks: Though the number of occurrences was observed to be low, it had direct effects on social and economic activities of the residents. The indicators of fire outbreaks were identified to be a combination of factors which include improper wiring in some homes by residents and artisans, improper siting of

food joints, filling stations and small skill industrial activities such as palm kernel processing. Ritz junction, Maamomo and Ogbojo, light industrial village and Zoomlion down in the Gbentana, Sutrana and Nii Ashaley zonal councils respectively were identified high risk of fire outbreaks. Ritz junction was found to be associated with cases of food joints sited close to mechanical shops with the potential of causing fire outbreaks. Maamomo or Adentan village is more of a slum made up of the indigenes associated with improper wiring and other uses of flammables like candles and mosquito coils. The Nii Ashaley communities identified with varied indicators such as improper wiring in Ogbojo and the light industrial area, improper siting of a gas filling station in the industrial area and Zoomlion down. Bushfires which used to be a major contributing factor for fire outbreaks was however ruled out because most of the vast lands have been cleared and occupied.

Road network, Drainage systems, and Footbridges: These hazards had both direct and indirect effects on the environment, social and economic activities. The road network was identified as a hazard in all four zones. It had a direct effect on the environment, social and economic activities of the people while the drainage system and footbridges impacted directly on the environment and social livelihoods of the people respectively ([Table 1](#)). At Presbyterian down, Ogbojo, it was observed that out of frustration, a resident had cut a trench through an uncompleted access road and drains which were causing flooding. The action resulted in denying access to motorist who applied that road.

Sanitation: The health and sanitation officer at the assembly identified a few major challenges with their work at the Municipality. Discharge of liquid and solid waste by residents during rainfall hours which flow alongside with stormwater had direct consequences on the environment, social and economic activities in the area. The major risk this poses include disease outbreaks which could have a toll on the Assembly's budget and pollution of the environment including drinking water sources especially broken pipelines. Interview with the proprietor of a basic school at Sraha stated their inability to cope with stench during rainfall due to some residents taking advantage to discharge their liquid waste into the open environment. Other problems associated with sanitation issues in the municipality include lack of landfills, frequent breakdown of the Assembly's waste collection vehicles leaving piles of waste for sometimes weeks before collection. The activities of tricycles although is to complement the Assembly's efforts, it rather poses as a threat because of the difficulty involved in regulating their activities. They end up dumping collected waste at unapproved places and also litter the streets during their movement with the uncovered refuse.

Quarry Sites: At Amrahia under the Koose zonal council, stone quarry activities were found to pose as a hazard. The cause of this hazard rather seems to be directly political due to lack of enforcement of Assembly's by-laws to regulate their operations, socially due to the land tenure system which allows individuals to lease their lands for any purpose, economically due to lack of suitable employment opportunities for the youth and environmental suitability of the place for these activities.

The quarry activities pose a high risk to the people working there because of the absence of protective gears during their operations. An interview with them proved that sometimes they get injured from the cracking of the stones. Vulnerable groups such as women and children were also found being engaged as labourers. Residents and motorists are also at risk because of the proximity of their activities to residential areas and damage caused to access roads. Economically properties such as buildings are at risk of being destroyed due to the use of slight explosives in blasting.

Irrigation: This activity was observed along a number of the dams dotted across. Though not identified as a high risk, its impact on the residents could be high. The waterbodies are contaminated from the anthropogenic activities of human settlements thereby polluting the water which is used for irrigating crops some of which are vegetables which are eaten either raw or slightly cooked.

Siting of gas filling station: The siting of fuel and gas filling stations could be identified as psychological, physical and chemical risks factors [7]. This phenomenon has been of major concern to both citizens and the government of Ghana due to the recent experiences in the country which led to the loss of lives. Apart from the loss of many lives and properties which can be caused through explosions and other disasters from wrong siting of filling stations [8], the high concentrations of gases also expose residents to increase the risk of cancers of about 2-21%. Field observations indicated the presence of filling stations within residential areas at Zoomlion down, and Nmai Dzorn on the Ashaley Botwe and the light industrial area within the Sutrana and Nii Ashaley zonal council respectively. All the locations were observed to pose risk to residents and economic activities. Some of the economic activities identified to be incompatible with the locations were welding, cooking of food by roadside vendors and small palm kernel oil processing which involves the use of naked fire or light which could cause flames if there is any leakage from the gas station. It is worth to note that, at Otinibi-Damfa a less densely populated area at Koose Zonal Council, an attendant of a gas filling station called for effective implementation of building permits to prevent the spouting of residential building around them in the near future since they first settled in the area.

Telecommunication mast: Due to the health implications of the mast to residents, monitoring on compliance by communication companies is very essential to minimize the impact. Although siting of the mast was on the low side throughout the municipality, it was obvious that some residents of Ogbojo under Nii Asheley Zonal Council had mixed reactions on the potential hazards of living close to telecommunication mast. Interviews with residents close to locations where the mast were sited, some were unaware of the potential hazards. Others, however, indicated vibration, radiation, and noise as some of the effects or hazards they were exposed to [9].

3.4.3. Change in Land Use and Encroachment as Drivers of Disaster in Adentan

Apart from the storm waters from the Akwapem range, another major contributing factor causing flooding is an encroachment on the dotted wetlands and dams in the Municipality. Increase in population and demand on land

for residential purposes has resulted in the sale of marginal and sensitive areas which include wetlands. Observations during the study revealed many of such wetlands were being filled and reclaimed for residential purposes. A decade ago, many of these wetlands were found in less developed areas allowing them to play their proper functions in the ecosystem which include adsorption of excess stormwater (Figure 2). However, observations in (Figure 3 and Figure 4) indicates that many of these wetlands and other reserved lands such as the aviation land and the industrial village for small-scale artisans have been encroached upon thereby posing as hazards to the resident communities surrounding them. The activities of artisans at the industrial village have become incompatible with the economic activities surrounding them. Some of such are active chop bars and restaurants, small-scale palm kernel oil processing, the sale of gas for domestic and commercial and even erection of unauthorized residential facilities within the whole area.

4. Conclusions

The study revealed that major hazards exposing residents to disasters in the Adentan Municipality are floods, encroachment on wetlands, road network, and sanitation issues. Other important hazards worth working at reducing their associated risk include filling stations, quarry sites, telecommunication mast, and fire outbreaks. These were identified to have a high risk of causing disasters. The direct causes of these hazards were associated with environmental conditions, social norms, and greed for land grabbing, unviability, and un conducive economic environment. Other contributing factors had to do with the incompatible economic activities with land use in the municipality.

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