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Drivers of Social Vulnerability to Flooding in an Urban Context: A Case Study of the Greater Accra Metropolitan Area

1 Introduction

Vulnerability assessments are conducted globally to understand the level of risk of places to hazards. Increasing losses and damages resulting from the impact of hazards has shifted researchers' attention to things that populations living in potentially hazardous areas could do to minimize the effects. This resulted in research studies in social vulnerability. Social vulnerability is a multidimensional concept that helps to identify the characteristics and factors that help communities to respond to the impacts of hazards (Chen et al., 2013; Cutter, Boruff and Shirley, 2003). Previous studies on vulnerability assessments have focused on physical losses and damages associated with exposure to hazards. However, disaster losses and damages are measured not only by the magnitude and duration of the disaster, but also by the capacity of the population to protect themselves, their livelihood and property (Chen et al., 2013). In addition, there are some non-physical social indicators that are affected by disasters that are usually not included in the computation of vulnerability. For instance, issues like place attachments, people's values etc. are critical. These social indicators are critical in assessing communities' vulnerability to hazards, but they differ from one context to the other (Chen et al., 2013). The differences in the context also determines that capacity of the people's resilience to hazards.

Social vulnerability, which helps to look at vulnerability as a social construct (Hewitt 1997; Blaikie et al. 1994; Cutter, Boruff, and Shirley 2003), also helps to identify the impact of hazards on individual groups within communities (Chen et al., 2013). Flooding has become a major environmental hazard in GAMA over the past 3 decades with substantial damages to properties and in some cases loss of human lives. There are several studies that have assessed the vulnerability of people and place to hazards (Cutter, Mitchell and Scott, 2000; Cutter, Boruff, and Shirley 2003; Chen et al., 2013) and measures that could be put in place to minimise the impact of hazards on people. A substantial number of these studies focused on addressing the physical engineering problems with little attention on the socially constructed problems. The physical location of population to potential hazardous places dominated the literature on vulnerability assessment, because these are the populations that usually report high losses and damages associated with hazards.

The degree of vulnerability is not solely dependent on the proximity to the hazard or the physical characteristics of a place, but also the social characteristics of the population in question (Cutter, 2000; Hinkel and Klein, 2007). Increasing population size and urbanization are critical issues that lead to the development of informal settlements and housing units in riskier environments. Also, the widening disparities in wealth and socio-economic status may bring about increasing losses and damages to disasters in the future because of the inability of

the people to cope with the situation (Mileti, 1999). Social vulnerability is therefore critical in vulnerability assessment especially in places where socio-cultural factors play critical roles in the wellbeing of the people. The social vulnerability of a population influences its ability to prepare for, respond to, and recover from hazard events. Thus, understanding the social vulnerability of people helps in building their resilience to hazards.

There is an ongoing debate on whether social vulnerability can be quantified or not, which indicators should be included in the social vulnerability assessment, and what types of results can best represent the magnitude of social vulnerability (Birkmann 2006; Montz and Tobin 2011; Chen et al., 2013). However, social vulnerability index has been estimated in several studies and used in different context. There is however, little of such studies in urban Ghana, which has diverse socio-cultural issues that are critical in computing social vulnerability index. Flooding is a critical problem in GAMA and all the physical vulnerability assessments that have been done, and the interventions put in place have not been able to address the problem of flooding. The belief among some of the population that flooding in GAMA is generally a behavioural issue needs to be critically assessed. Secondly, the local political space, which is linked to land acquisition impacts on the social vulnerability of the people. Finally, the different livelihood activities in the area are also important in social vulnerability assessment.

GAMA therefore presents a unique context of cultural and political diversity to re-examine the indicators of social vulnerability. Building on previous studies on social vulnerability (Hewitt, 1983; Cutter, Boruff and Shirley, 2003; Chen et al., 2013), we focused on social indicators of vulnerability in a developing country urban area, which we believe is different from what was previously investigated by other studies. GAMA is prone to flooding and densely populated with different groups of people. There are also diverse socio-economic activities within GAMA and different settlements. Further, there is a mix of traditional political systems in the area that influences developmental activities in the area.

2 Data and Method

Data for the analysis are derived from the 2017 Cities and Climate Change Survey conducted by the Rgional Institute for Population Studies, University of Ghana, and the 2010 Population and Housing Census of Ghana conducted by the Ghana Statistical Service.

The study applied cross-sectional representative household survey. The household survey used a multistage approach, using the updated National Master Sampling Frame constructed from the 2010 Ghana Population and Housing Census, by the Ghana Statistical Service; to select the required number of households. At the first stage all seven (7) GAMA districts out of the 16 districts located in the Greater Accra Region were selected. Two communities per each district were selected were purposively selected based on prior information of flood risks history since independence. Next, three enumeration areas (EAs) or primary sampling units (PSUs) were selected from each of the communities selected yielding 42 enumeration areas. An extensive listing and map-spotting exercise of all eligible households in the selected EAs were carried out. The list of names and detailed addresses of all households within the canvassed EAs formed the frame for the selection of households. The next stages of selection, 30 households were systematically selected from the ordered sampling frame, using an equal

probability procedure. Total samples of 1,290 households were selected. Of these, 1,252 households were identified, and interviews were completed with 1,230 households, yielding a response rate of 95.3%. Of these a little over 50 percent had experienced flood in past five years.

The main outcome variable is level of vulnerability among households in the GAMA region of the Greater Accra. Several variables were asked to generate these separate scores using the Principal Component Analysis (PCA) and aggregated at the EA level.

Table 1: Variables used in the computation of social vulnerability

1. Socio-demographics	
• Sex ratio for community	Census
• Median age of the population	Census
• Percentage of population under 5 years old	Survey
• Percentage of population aged 65 years and above	Survey
• Population dependency ratio	Survey
• Average number of people per household	Survey
• Percentage of the population 25 years and above with tertiary education	Census
• Percentage of the population 20 years and above with secondary education	Census
• Literacy rate of the population aged 15 years and above	Census
2. Livelihood	
• Employment status of household head	Survey
• Average number of households working in primary sector	Census
• Average number of households working in secondary sector	Census
• Average number of households working in tertiary sector	Census
• Percentage with access to financial assistance from financial institutions	Survey
• Percentage with access to alternative livelihood	Survey
3. Housing quality	
• Quality of material for construction of wall	Survey
• Quality of material for roofing	Survey
• Quality of material for floor	Survey
• Percentage of rooms occupied by household	Survey
• Percentage of households that sleep outside designated sleeping rooms	Survey
4. Health indicators	
• Distance to the nearest health facility	Survey
• Malaria incidence rate	Survey
• Diarrhoea incidence rate	Survey
• Cholera incidence rate	Survey
• Typhoid incidence rate	Survey
• Percentage with injuries	Survey
• Percentage with access to ambulance services	Survey

• Percentage of the population with disabilities	Survey
• Percentage of household's dependent on wood as main cooking fuel	Survey
5. Water and sanitation	
• Main source of water for drinking	Survey
• Main source of water for domestic use	Survey
• Type of toilet facility	Survey
• Main method of refuse disposal	Survey
• Main method of liquid waste disposal	Survey
6. Socio-political indicators	
• Percentage with social insurance against hazards	Survey
• Percentage with access to relief services/NGO support	Survey
• Percentage belonging to social group	Survey
• Percentage with access to remittances	Survey
• Percentage with access to early warning system	Survey
• Percentage with access to information (churches, mosque, radio etc.)	Survey
• Percentage that participated in meetings where preparation for emergencies or disasters were discussed	Survey
• Percentage with access to emergency response systems	Survey
• Percentage with access to fire service	Survey
• Percentage with access to security services	Survey

Analytic Plan

The framework for the study is based on the IPCC special report on extreme events (SREV) conceptualisation of risk as emanating from the intersection between exposure to extreme events and social vulnerability (IPCC, 2012).

- Develop social vulnerability indices for the study areas
    - Testing the hypothesis "populations that have higher social vulnerability index are more exposed to floods than populations lower social vulnerability index".

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