

## Research

# Household flood vulnerability and temporary relocation in resource-scarce urban Accra

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Received: 29 May 2025 / Accepted: 5 February 2026

Published online: 26 February 2026

© The Author(s) 2026 [OPEN](#)**Abstract**

Existing research on climate-related human mobility centres on population vulnerability, yet gaps remain in examining how sociodemographic factors shape household mobility outcomes. This research uses household survey data from two resource-poor urban communities prone to perineal flooding to explore the major components and indicators of flood vulnerability (adaptive capacity, sensitivity and exposure) that influence the temporary relocation of households. The results show besides water and sanitation, community vulnerability significantly varied by livelihood strategies, social capital, health status, food insecurity, and climate variability exposure. Further analysis reveals that while stronger social ties and better sociodemographic profiles (components of households' adaptive capacity) are protective against temporary relocation, household food insecurity (a component of sensitivity) has the reverse effect. Additionally, migrants, compared with non-migrants, were more likely to relocate during floods. This study highlights the need for policy responses to be differentiated between the different components of vulnerability that affect the mobility of households experiencing floods.

**Keywords** Adaptive capacity · Sensitivity · Exposure · Relocation · Households

## 1 Introduction

Climate-induced human movement is a keenly debated topic in current scholarship on global warming and its consequences [1–4]. While the effects of climatic stressors such as floods are widespread, their effects on coastal urban settings, particularly in sub-Saharan African communities, are grave [5–8]. This can be attributed in part to rapid urbanization, poor planning, and the continuous occupation of close wetlands by humans, which has increased the frequency and severity of floods in most low-resource coastal communities in SSA [9–13]. Unfortunately, various projections indicate that flood hazards in such cities will continue to increase [14, 15]. Various water-related events including floods have long influenced human mobility [16]. The movements of households and individuals, be they temporary or permanent relocations, have been a means of adapting to climatic stressors such as floods and droughts. To effectively address the significant challenges and costs associated with unplanned movement following disasters, it is essential to understand the specific household characteristics that drive relocation decisions. Thus, this study employs a vulnerability framework to examine how the components of exposure, sensitivity, and adaptive capacity collectively determine a household's propensity to

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relocate after flooding. Exposure is the nature and extent of its contact with the flood; sensitivity, or the degree to which it is affected by the event, while adaptive capacity systems ability to adjust and reduce potential damage [17].

There are approximately 270 million international migrants globally [18]; however, this number reflects only a small portion of the overall movement of people relocating within their own countries [19]. Although most movements by individuals are by choice, involuntary migration due to conflict or environmental hazards is triggered by the need to survive [20]. Data from the International Displacement Monitoring Centre show that “survival migration” by internally displaced people has been on the rise over the past decade, with as many as 80% of this situation occurring in urban areas [21].

While climatic hazards such as floods affect entire communities, their impact on households varies due to their uneven exposure to hazards, sensitivity, and adaptive capacity to withstand them [22–24]. These differences in households may be reflected in the varying structural and non-structural measures by which households respond to floods. The relationship between environmental risk and relocation is complex and not straightforward. People’s decisions to migrate are shaped by a range of factors—including economic, social, political, and demographic conditions, along with individual or household preferences—which interact with flood risk and shape the effectiveness of adaptation strategies [25–27]. While structural measures such as levees and drainage systems offer physical protection, non-structural measures like land-use planning and early warning systems aim to reduce vulnerability by enhancing preparedness and informed decision-making.

Despite the limited empirical research on the sociodemographic and economic drivers of climate-induced temporary relocation in resource-dependent coastal communities, a pressing question remains: what are the key indicators of household vulnerability (across exposure, sensitivity, and adaptive capacity) that predict migration decisions following flooding events?

The current study contributes to the growing research in three keyways. First, even though research on outmigration and relocating because of climate-sensitive hazards is still evolving, scholarship is skewed towards findings on the impact on whole communities, such as trapped populations and government actions [28, 29]. There are also more recognized models and theories explaining relocation due to natural hazards situated within the community resilience literature [30, 31], but these models rarely address household characteristics. Thus, critical gaps exist in our current understanding of the drivers of household relocations because of floods. Second, in addition to identifying vulnerable households and their coping strategies, disaster preparedness efforts must also identify disparities in the various components/indicators of household vulnerability that inform households’ decisions to stay or leave, in addition to directives from local political or administrative units to relocate to address the consequences of floods correctly. Finally, within the glossary of structural and non-structural adaptation measures, retreating/relocating from flood-prone areas ensures reduced future exposure to hazards [32, 33]. However, this exposes households to challenges such as uncertainties with respect to their livelihoods, financial burdens, and emotional attachments to their previous residences [34–36]. In this work, we examine the conditions that make households vulnerable to floods and the components of their vulnerability that drive household relocation following exposure to floods in resource-scarce coastal communities in urban areas. Such locations (poor coastal urban communities) have multiple layers of unique conditions that exacerbate the effects of climate variability and changes on households.

## 1.1 The concept of vulnerability and its measurement

The concept of vulnerability to climatic hazards has evolved over time as our understanding of climate change and its impacts has deepened. Vulnerability has often been understood as a characteristic of a population or region that made it more susceptible to the impacts of climate hazards, such as floods, droughts, and extreme weather events [37]. This was often measured in terms of physical exposure, such as the degree to which infrastructure or housing was located in areas at risk of flooding or the extent to which agricultural production was dependent on rainfall.

However, over time, the concept of vulnerability has broadened to encompass a wider range of social, economic, and political factors that contribute to a population’s exposure and ability to cope with climate hazards [17]. This includes factors such as poverty, access to resources, social inequality, and governance structures [38]. For example, a community with a high level of poverty and limited access to resources may be more vulnerable to the impacts of a drought than a more affluent community, as they may lack the resources to adapt or cope with the impacts. Although the concept and definition of vulnerability remain very fluid, the International Panel on Climate Change considers it a “function of the exposure of a system to climatic hazards, its sensitivity to those hazards, and its adaptive capacity to cope with or recover from their impacts” [11].

Several methods have been employed in the assessment of vulnerability to climate change. These methods include multicriteria decision making via either subjective or objective weighting techniques; statistical models such as principal component analysis (PCA) and Bayesian belief networks; and machine learning models such as convolutional neural networks (CNNs) and network analysis [27]. Although these methods and others have some success in measuring the vulnerability of communities, they are less sensitive in determining the level and differences of household vulnerabilities in similar environments or geographical spaces. Thus, in this study, we construct a vulnerability index that considers specific household social, demographic, and economic factors that influence vulnerability to floods. The generation of indices is seen as useful, as it is considered a robust methodology to ensure replicability [39].

The benefits of generating a household vulnerability index include the following:

1. **Identifying vulnerable households:** An indicator of household vulnerability can be used to identify households that are at greater risk of being impacted by various hazards and stressors, such as natural disasters, economic shocks, or health crises. These data can be used to direct resources and interventions to the homes that most need them.
2. **Comparing vulnerability levels among households:** A home vulnerability index can offer a standardized way to do this. This can aid in identifying trends and factors that contribute to vulnerability, which can help with program and policy design.
3. **Monitoring changes over time:** A household vulnerability index can be used to monitor changes in vulnerability levels over time. This can help track the effectiveness of interventions and identify emerging risks and opportunities for intervention.
4. **Advocacy and policy influence:** A household vulnerability index can provide evidence to advocate for policy changes and investments to address the underlying drivers of vulnerability [40]. It can also influence the allocation of public resources to address the needs of vulnerable households.

## 2 Methods

### 2.1 Study area

Located at 5.603°N, 0.187°W, Ghana's coastal capital, Accra, experiences a bimodal rainfall pattern. Annual precipitation in this southern city averages between 790 mm along the coast and roughly 1270 mm further north. Situated 61 m above sea level, Accra covers an area of about 114 km<sup>2</sup> and has a population of nearly 2 million people [41]. Accra is a major trade and commercial hub in Ghana and is a destination for several rural–urban and urban–urban migrants from all the developmental zones in Ghana. Historically, cities and surrounding communities have experienced several floods, which are attributed to the low-lying nature of the land, an increase in erratic rainfall and the current rise in population growth with a non-commensurate investment in waste management and adequate drainage systems [42]. The spatial and temporal dynamics of both institutional and biophysical factors contribute to Accra's flooding “riskscape” [43].

The study communities were—James Town (JT) and Agbogbloshie (ABG) both coastal communities in Accra. JT is an indigenous Ga community, whereas ABG is a multiethnic community set in a major market area and a major destination for migrants. These communities are two low-income, high-density communities, which were purposively selected to represent the environmental contexts within Accra's urban poor landscape. Both are officially classified as slums and are located along the Odaw River catchment [44]. Additionally, these communities were selected given the effect of climate change and variability on their livelihood [45], and they revealed that rapidly urbanizing sites experienced several environmental factors interacting with social and institutional diversity that exposed households to flood risk.

### 2.2 Study design and sampling

The present study was part of a broader initiative—the Climate Change Adaptation Research Training for Capacity Development (CCARTCD) project, residence in the University of Ghana, which aimed to deepen understanding of how climate change impacts the health and food security of residents in low-income, coastal urban areas of Accra, Ghana. The study utilized a two-stage, stratified cluster sampling approach. In the first stage, 13 enumeration areas (EAs) were selected as primary sampling units, stratified by the two study localities (James Town and Agbogbloshie). The selection was performed with probability proportionate to size (PPS), based on the census data provided by the Ghana Statistical Service. This resulted in the selection of eight EAs in James Town and five in Agbogbloshie. In the second stage, within

each selected EA, 23 households were randomly sampled from a complete listing of all households resulting in a total of 299 household. With a response rate of 90% a final sample of 270 household consented to the study. All eligible residents within the sampled households were invited to participate and were interviewed. A household is defined as co-residing individuals sharing the same living arrangement under one acknowledged head [46]. Pretested questionnaires were administered to the heads of households.

### 2.3 Ethical consideration

Study was approved by the Noguchi Memorial Institute for Medical Research—Institutional Review Board (NMIMR-IRB), University of Ghana (Protocol Number: 105/12-13). All participants provided written or oral informed consent prior to their involvement.

### 2.4 Computing the household flood vulnerability index

We first adopted a scoping review approach for a comprehensive understanding and selection of sociodemographic and economic indicators of household vulnerability to climatic hazards, particularly floods. Indicators are considered the integral characteristics of a system and determine and assess the condition of that system. The assembly of indicators within a conceptual framework adheres to standards encompassing usefulness, appropriateness, data availability, and recall ease.

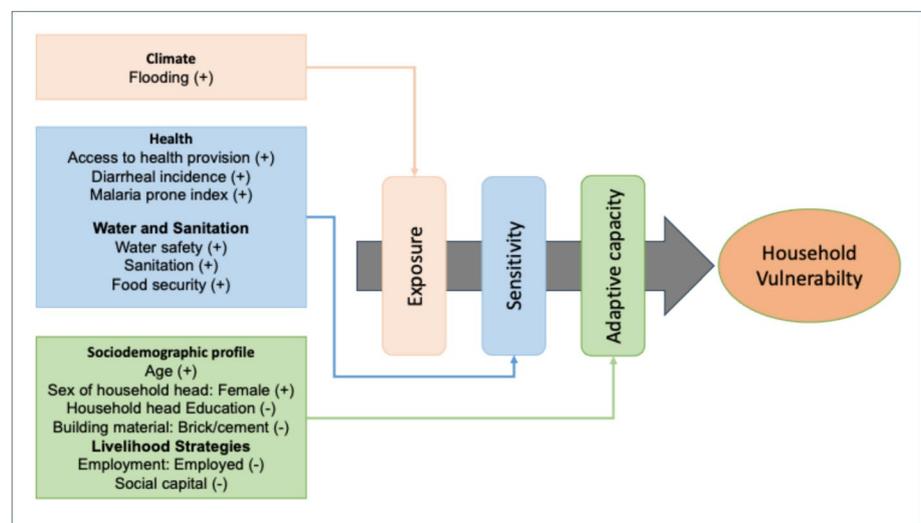
The direction- or effect-selected indicators contributing to the vulnerability of households are presented in Fig. 1. Vulnerability, defined here in line with the IPCC and others [47–49], arises from a system’s exposure and sensitivity to external stresses (such as floods) combined with its adaptive/coping capacity to respond.

**Adaptive capacity** refers to the characteristics of households that allow them to adjust or modulate the potential damage caused by floods. The three identified domains and their selected indicators that influence the adaptive capacity of households are as follows: (A) the age of the household head represents the sociodemographic and economic profile [50], the sex of the household head [51], the educational level of the household head [52] and the built material of the housing structure [53]; (B) livelihood strategies are represented by the employment status of the household head and members [54]; and (C) the social network is represented by the household’s social capital [55, 56].

**Sensitivity:** In this study, sensitivity is considered “the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli [47, 57, 58]. Strictly speaking, sensitivity cannot be measured but can be assessed by the element or aspect of households being studied that is known to be sensitive and/or respond to the climatic stressor in question. These aspects of the households are (D) the malaria-prone index [59], (E) diarrheal incidence [60] and (F) access to health centres [61, 62].

**Exposure:** This is considered “the nature and degree to which a system is exposed to significant climatic variations” [47]. Exposure is the extent or effect of a flood [63–65]. The survey questionnaire used captured the impacts of flash floods on the households; consequently, the vulnerability index was computed as a function of exposure, sensitivity, and adaptive capacity

**Fig. 1** Conceptual framework of indicator contributing to household vulnerability. A positive (+) sign indicates that an increase in the unit of the variable/indicator increases the vulnerability of a household, and a negative (–) sign indicates that an increase in the unit of the variable/indicator decreases household or community vulnerability. Owing to variation in the units for the indicators of vulnerability, it was necessary for each measure to be standardized



conditional upon the flash flood. A more detail application of this framework is reported in Christian et al. [66] presents a more detail account of the framework for the index [66].

### Step 1:

We utilize the balanced/equal weighted average method to calculate a household vulnerability index. Given the different units of indicators, they are standardized based on a similar procedure used for the development of the Human Development Index [67].

The equation for the standardization of units is shown below.

$$index_{sh} = \frac{S_h - S_{min}}{S_{max} - S_{min}} \quad (1)$$

where  $s_h$  represents the indicator for a household  $h$ , and  $s_{min}$  and  $s_{max}$  are the minimum and maximum values for that indicator for the household, respectively. By employing Eq. (2) below (the standardized values for the indicators are then averaged), we generate values for the components (i.e., sociodemographic profile, livelihood strategies, social networks, health, food, water, sanitation and exposure).

### Step 2:

$$M_h = \frac{\sum_{i=1}^n index_{s_h^i}}{n} \quad (2)$$

where  $M_h$  represents one of the seven components for a household  $h$  (sociodemographic profile (SDP), livelihood strategies (LS), social networks (SNs), health profiles (HPs), food security (FS), water and sanitation (WS) and climate variability (CV)),  $index_{s_h^i}$  represent the subcomponents/indicators, indexed by  $i$  making up each major component.  $n$  represents the number of subcomponents in each major component.

The Livelihood Vulnerability Index (LVI) used in this study is composed of seven key components that together capture the multidimensional nature of household vulnerability to flooding. These include the sociodemographic profile (SDP), which reflects a household's underlying capacity to anticipate, absorb, and recover from shocks, based on factors such as the age, sex, and education level of the household head, as well as housing materials and perceived well-being. The livelihood strategies (LS) component represents the household's economic stability and resilience, measured through employment status and the number of economically inactive members. Social networks (SNs) refer to the household's access to informal support systems, such as friends and relatives, which can play a critical role in mitigating the effects of floods. The health profiles (HPs) component captures household sensitivity to climate impacts, particularly by assessing proximity to healthcare, incidence of diarrheal diseases, and malaria exposure. Food security (FS) indicates the household's access to sufficient and reliable food, with food insecurity contributing to greater vulnerability during and after flood events. The water and sanitation (WS) dimension evaluate the availability and quality of water supply and sanitation facilities, where lack of improved WASH infrastructure increases health risks in flood-prone settings. Lastly, climate variability (CV) reflects the degree to which households have been exposed to flood events and their severity, representing the physical risk component of vulnerability. Together, these seven components provide a comprehensive and context-sensitive basis for evaluating household-level flood vulnerability in resource-constrained urban environments.

The average of the values for  $M_h$  is then computed as the household vulnerability index (HVI): shown in Eq. 3.

$$HVI_h = \frac{\sum_{i=1}^7 wm_i M_{hi}}{\sum_{i=1}^7 wm_i} \quad (3)$$

## 2.5 The empirical model

The empirical equation estimated was a relocation function, which is a logit regression. The relocation decision equation, which is equivalent to Eq. (4), is specified as a relocation function, or logit regression, was the empirical equation that was estimated (Eq. 4). This is:

$$Relocation\ duetoflood = f(SEP, LS, SC, HP, WS, FS, CV; MigrationStatus) \quad (4)$$

The study employed a binary dependent variable indicating household relocation adopted specifically as a flood coping strategy. This variable was assigned a value of 1 if a household relocated due to flooding and 0 otherwise. Key explanatory variables comprised continuous indices representing distinct dimensions of household vulnerability: sociodemographic profile (SEP), livelihood strategy (LS), social capital (SC), health status (HTH), water and sanitation access (WS), food security (FS), and climate variability exposure (CV). For each index, a higher numerical value signifies a greater degree of household vulnerability within that specific domain. Recognizing its potential confounding influence, particularly given the significant migrant population and differences in place attachment observed, household migration status (MS) was included as a binary control variable. Migrant households were coded as 1, while non-migrant households were coded as 0. All covariates, except for migration status, are continuous measures.

### 3 Results

The Household Vulnerability Index (HVI) scores reveal notable differences between the two coastal communities, JT and ABG. Across the overall index and its key components—exposure, sensitivity, and adaptive capacity—variations highlight the unique risk profiles of each location. These differences reflect underlying disparities in socioeconomic conditions, infrastructure, and coping mechanisms, offering insights into where targeted interventions may be most needed.

#### 3.1 Adaptive capacity

*Sociodemographic Profile (SEP)*: ABG demonstrated significantly greater vulnerability than James Town (ABG:  $0.356 \pm 0.19$ ; James Town:  $0.298 \pm 0.19$ ;  $p = 0.02$ ). Contributing factors included a higher proportion of uneducated household heads and non-brick/cement buildings in ABG, though James Town had more elderly heads.

*Livelihood Strategies (LS)*: James Town households exhibited significantly higher vulnerability than ABG (James Town:  $0.362 \pm 0.36$ ; ABG:  $0.197 \pm 0.24$ ;  $p = 0.02$ ).

*Social Capital (SC)*: ABG showed marginally higher vulnerability than James Town (ABG:  $0.353 \pm 0.24$ ; James Town:  $0.296 \pm 0.24$ ;  $p = 0.07$ ), potentially influenced by its larger migrant population.

#### 3.2 Sensitivity

*Health Status (HTH)*: ABG households were significantly more vulnerable than those in James Town (ABG:  $0.319 \pm 0.24$ ; James Town:  $0.239 \pm 0.22$ ;  $p = 0.006$ ). This stemmed from a higher prevalence of recent diarrhoea cases and lack of mosquito-proof screens, despite James Town having greater average distance to health posts.

*Water & Sanitation (WS)*: No significant difference was observed between the communities.

*Food Security (FS)*: ABG households were significantly more vulnerable than James Town households (ABG:  $0.356 \pm 0.26$ ; James Town:  $0.103 \pm 0.17$ ;  $p = 0.001$ ), a finding potentially linked to ABG's poorer overall sociodemographic profile despite its role as a food market.

#### 3.3 Exposure

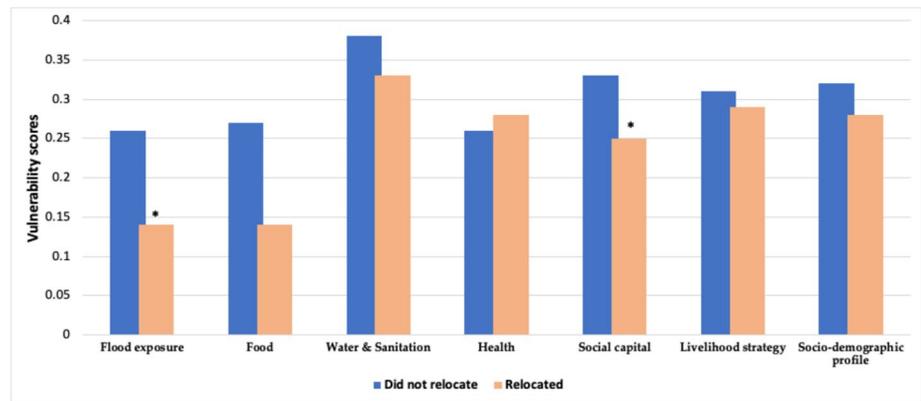
*Climate Variability (CV)*: ABG experienced significantly greater exposure than James Town (ABG:  $0.250 \pm 0.26$ ; James Town:  $0.103 \pm 0.17$ ;  $p = 0.001$ ), reflecting higher rates of household flooding and impacts within the neighbourhood.

*Overall Vulnerability: LVI*: ABG exhibited significantly greater overall vulnerability than James Town (ABG:  $0.333 \pm 0.10$ ; James Town:  $0.266 \pm 0.10$ ;  $p < 0.0001$ ).

#### 3.4 Associations between household vulnerability components and relocation due to floods

Temporary relocation to family/friends outside the community was adopted by 22.0% of households as a flood coping strategy. Migrant households were markedly more likely to relocate (31.7%) than non-migrants (9.5%). As shown in Fig. 2, households that relocated differed significantly from non-relocating households across key vulnerability dimensions. Relocated households exhibited significantly higher food insecurity (mean FS:  $0.27 \pm 0.25$  vs.  $0.14 \pm 0.20$ ;  $*p^* < 0.05$ ) and greater flood exposure (mean CV:  $0.26 \pm 0.44$  vs.  $0.14 \pm 0.33$ ;  $*p^* < 0.05$ ), but lower social capital vulnerability than non-relocating households.

**Fig. 2** Mean sub-components of vulnerability by household coping (relocation) status  
\* $p > 0.05$



### 3.5 Predictors of relocation due to floods

The model (see Table 1) fits significantly better than an empty model (likelihood ratio chi-square = 28.64,  $p < 0.05$ ). Household socio-demographics, social capital, food security and migration status were statistically significant predictors of households relocating after floods.

The analysis reveals distinct patterns in how different vulnerability factors influence households' decisions to relocate as a coping strategy after floods. Sociodemographic vulnerability shows a negative association with relocation; for every one-unit increase, the log odds of relocating versus not relocating decrease by 2.35, meaning households with greater sociodemographic vulnerability are less likely to move. Similarly, social capital also exhibits a negative relationship, with a one-unit increase resulting in a decrease of 2.66 in the log odds of relocating; this implies households possessing poor social capital are less inclined to choose relocation. Conversely, food security vulnerability demonstrates a positive effect; a one-unit increase in food insecurity leads to a 2.43 increase in the log odds of relocating, indicating that more food-insecure households are more likely to relocate. Additionally, migrant households are significantly more likely to adopt relocation as a coping strategy during floods compared to non-migrant households.

**Table 1** Logit regression of determinants of households relocating in response to floods

	Coef	SE	Sign. level
<b>Vulnerability components</b>			
Sociodemographic profile	-2.36	1.37	0.085
Livelihood strategy	-0.59	0.71	0.405
Social capital	-2.66	1.03	0.010
Health	-0.18	1.02	0.861
Water and sanitation	-1.49	0.98	0.129
Food insecurity	2.43	0.98	0.014
Exposure to floods	0.79	0.60	0.187
<i>other parameters</i>			
Migration status	1.53	0.54	0.005
Constant	-0.72	0.69	0.292
Pseudo R2	0.1871		
Prob > Chi2	0.0004		
Number of observations	145		

Note that the asterisks indicate significant levels: \* implies significance at the 10% level; \*\* implies significance at the 5% level; \*\*\* implies significance at the 1% level

## 4 Discussion

While the planned relocation of population groups exposed to climate hazards has been well researched [68, 69], individual- and household-level relocation as a coping strategy remains poorly researched. In this work, we assessed the vulnerability of two low-income urban settlements to flood hazards and household relocation due to floods. Notably, the vulnerability of low-income citizens to flooding is shaped by an intricate interplay of socioeconomic and geophysical factors that encapsulate exposure, sensitivity, and the capacity to adapt. While exposure to a hazard is subject to the location of the household, the level of sensitivity derives from the characteristics and functions or activities of the system and the capacity to adapt drives from the ability to draw on resources to adjust effectively to the effects or impacts of the hazard. Hence, relocation avoids the hazard for the point in time. Low-income settlements exposed to floods are particularly vulnerable due to limited access to resources that enhance their ability to adapt. Access to physical, human, financial, natural, and social resources, including institutions and political resources, tends to increase people's ability to live with floods to varying levels [70].

### 4.1 Implications of the James town versus ABG HVI comparison

Flooding disproportionately burdens resource-poor communities like James Town (JT) and Agbogbloshie (AG) in Accra, with household responses and impacts modulated by differential vulnerability. Our analysis revealed AG was significantly more exposed and sensitive to floods, resulting in greater overall vulnerability compared to the more indigenous JT, which benefits from relatively better infrastructure. AG's heightened vulnerability stems from extreme population density, precarious infrastructure developed through informal settlement, and a high migrant population, factors historically linked to inadequate services and sociodemographic disadvantage [71]. Consequently, AG residents face greater health, water, sanitation, and climate variability risks. Paradoxically, despite AG's role as a major food market hub, households exhibited greater food insecurity vulnerability (measured by meal frequency and adequacy), potentially reflecting limitations in the metric or household composition differences. In contrast, AG households demonstrated less livelihood vulnerability, likely due to prevalent trading activity within the market, compared to higher unemployment in JT. Critically, while AG's vulnerability warrants intervention, the community's vital economic role generates significant resistance to relocate [72]. Mirroring experiences elsewhere where resettlement offers limited economic compensation [73]. This underscores that upgrading essential amenities and preventing further congestion, aligned with sustainable development goals for informal settlements [74], is often the more viable strategy than relocation—despite the current lack of a clear Ghanaian urban planning agenda for such areas like AG.

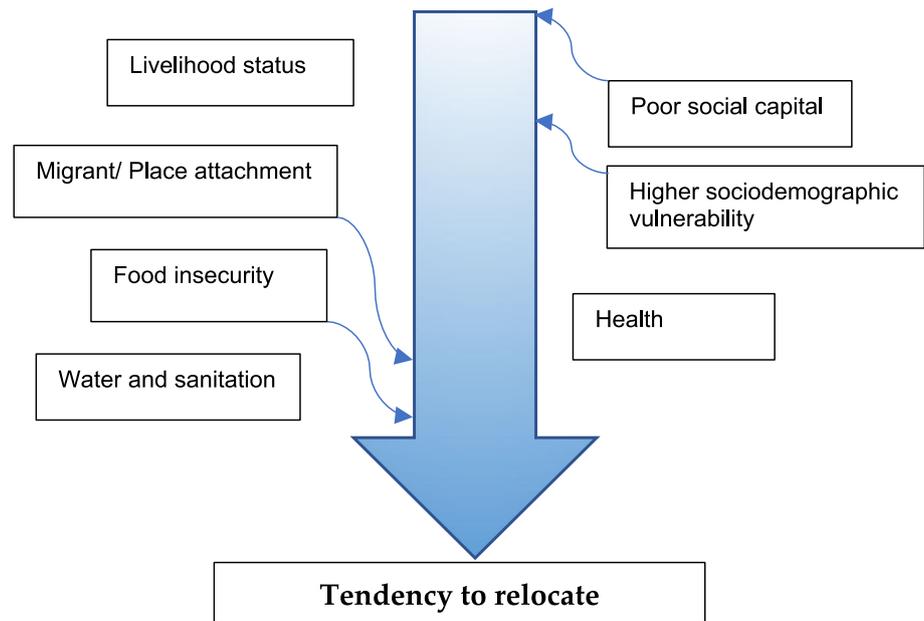
### 4.2 Household characteristics and relocation due to floods

We found that the tendency of households to relocate is a function of sociodemographic vulnerability, migration status or place attachment, food security status, and access to social capital. The tendency to relocate increases with increasing darkening of the colour gradient in the relocation escalator model (Fig. 3). Migrant households, those with low social capital and those with low sociodemographic profiles are less likely to relocate, which resonates with the concept of trapped populations [75]. The results indicate that persons with low social capital cannot rely on neighbours for support, as they receive less support (low receive-give ratio). Poverty and limited access to financial resources can make it difficult for people to relocate or recover from flood damage. This can lead to a cycle of poverty and vulnerability, where households are repeatedly exposed to flooding and are unable to break free from the impacts of these disasters.

Hence, when exposed to flood hazards, they are likely to be involuntarily immobile, as described in the aspiration-capability framework [76]. These are households with the aspiration to relocate but lack the capacity [77].

Mobile households have both the aspiration and capacity to move, as may be the case for migrants who, at the same time, do not have an attachment to a place. The acquiescent have neither the capability nor the aspiration to relocate; they just absorb the shock [77, 78]. In our model, sensitivity measures such as health, water and sanitation, and livelihood status have no influence on relocation in the face of floods. In Fig. 3, these have no connectors pointing to the middle arrow. [79] pressure—state—response model refers to sensitivity indicators as specific forms of unsafe

**Fig. 3** A flood-triggered relocation model of a low-income urban setting. Source: Authors' construct



conditions such as living environments and risky livelihood activities in which the vulnerability of a population is manifested in the time and space of a hazardous context.

Floods may cause a household to migrate temporarily or permanently, however there are several intricate factors that influence a household's decision to or ability to relocate [80]. Given that, in this study, households that were more vulnerable with respect to their sociodemographic profile and social capital were less likely to relocate, this suggests a lack of both financial and social capital to facilitate their relocation to cope with floods. This result is consistent with that of Black et al. [80], who reported that households with low to medium sociodemographic profiles are often trapped in situ during disasters or where they have been displaced following a disaster. Conversely, relocation/mobility from flood risk settlements, even in more developed countries, is stronger for high-income categories and more educated households. Mycoo [81] also concludes that relocation in response to climate variability is dependent on economic opportunities, asset ownership, housing, social services, and physical infrastructure [81]. On the other hand, households that are more food insecure (a component of household sensitivity) are more likely to relocate because of floods.

## 5 Conclusion

In this study, a little above a fifth of the respondents had relocated temporarily to join family and friends as a coping strategy during floods in the settlement. Relocation is significantly greater in ABGs, where overall vulnerability is high, mainly due to frequent exposure to floods, poor sociodemographic profiles of households, poor social capital, and greater food insecurity. Relocating from flood hazards can help minimize losses as an incremental step toward building progressive or transformational adaptations. There is a growing proportion of urban residents who live in low-income urban settings where flood risk-reducing infrastructure such as paved roads and storm drains, as well as resilience-enhancing services such as emergency services, is non-existent. With a projected increase in the frequency and intensity of flooding resulting from climate change and socioecological changes (IPCC, 2022), local coping measures could be promoted to minimize losses. We acknowledge the limited geographical scope and the cross-sectional nature of current research. Its cross-sectional design restricts the ability to infer causal relationships between climate-related exposures and household outcomes. Second, the relatively small sample size limited the possibility of conducting robustness checks and disaggregated analyses, which may affect the generalizability and precision of the findings. These limitations are acknowledged, and future research is planned to incorporate larger, more diverse samples and longitudinal designs to enhance the strength and applicability of the results.

*Policy recommendation:* Considering these findings, we recommend a strategic shift in flood resilience policy, moving beyond a primary reliance on physical infrastructure to a multifaceted approach that directly strengthens the adaptive capacity of vulnerable households. This entails implementing targeted interventions designed to foster robust social

networks and formalize community-based support systems, which serve as a critical buffer against displacement. Concurrently, to directly counter the key driver of relocation, household food insecurity should be addressed by integrating direct food aid and shock-responsive safety nets into disaster risk reduction plans. Additionally, attention must be paid to migrant populations, who require tailored support mechanisms. Ultimately, for policies to be effective, they must be informed by nuanced, local-level vulnerability assessments that account for the significant sociodemographic disparities in livelihood strategies, social capital, and health, ensuring that resources are allocated to address the specific drivers of vulnerability in each context.

**Acknowledgements** The author gratefully acknowledges the support provided by the International Development Research Centre (IDRC), Canada, through the Climate Change Adaptation Research Training for Capacity Development (CCARTCD) Project, hosted by the Regional Institute for Population Studies (RIPS). This support contributed significantly to the data used in this study.

**Author contributions** AKC led the conceptualisation of the analysis and in collaboration with SNAC and BDD. AKC and RTL were responsible for drafting the complete manuscript. All authors contributed to the review of the manuscript. All authors read and approved the final version of the manuscript.

**Funding** Data collection for the doctoral research of Aaron Kobina Christian was supported by the International Development Research Centre (IDRC), Canada, through the Climate Change Adaptation Research Training for Capacity Development (CCARTCD) program.

**Data availability** All data associated with this study are available upon reasonable request through an established ethical review procedure. Requests for access should be directed to the corresponding author and will be considered in accordance with institutional and ethical guidelines.

## Declarations

**Ethics approval** Ethical approval for this study was obtained from the Noguchi Memorial Institute for Medical Research–Institutional Review Board of the University of Ghana (Certified Protocol Number 105/12-13). The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki.

**Consent to participate** Informed consent (written and/or oral) was obtained from all participants prior to their involvement, with consideration for participant literacy and preference.

**Consent for publication** Written informed consent for participation and publication was obtained from all respondents included in the study. Participants were assured of anonymity and their right to withdraw at any stage without consequences.

**Competing interests** The authors declare no competing interests.

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