IMPLICATIONS OF GENDER-RELATED DIFFERENCES FOR PLUVIAL FLOOD RISK PERCEPTION AND PRECARITY IN NIGERIAN CITIES

[1]Temitope AIYEWUNMI (PhD)
[1]Department of Geography, School of Arts and Social Sciences
Sikiru Adetona College of Education Science and Technology
Omu-Ajose, Ogun State Nigeria

[2]Heather SANGSTER (PhD), & [3]Sarah CLEMENT (PhD), [4]Neil MACDONALD (Prof)
[2, 3& 4]Department of Geography and Planning, Risk and Uncertainties
School of Environmental Planning, University of Liverpool, Liverpool, U.K.

Abstract
Climate change represents one of the most challenging threats to sustainable development in Africa. There is an increasing need for knowledge focused on flood risk perception, as it is crucial for understanding how to develop effective and inclusive flood risk management. Using Ijebu-Ode, Nigeria as a case study, public awareness and understanding of flooding issues are explored, coupled with an assessment of individual and community responses and their adaptive capacity. Both qualitative and quantitative research methods are applied to enable a wide information base in a 'data poor' region. Air temperature and rainfall data (1989-2018) were sourced from the Nigerian Meteorological Station (NIMET, Ijebu-Ode) via national portal for the purpose of daily and monthly trend analysis. The primary data were gained via street surveys using structured questionnaire (300n) for the purpose of exploring the relationship between flood risk perception, precarity, and gender in an (in)formal settlement and best approaches to mitigate future flood disaster risks in Ijebu-Ode. Findings provide insights for many other comparable cities in West Africa and beyond, especially those suffering a history of pluvial flooding, characterised by a young population, a mix of formal and informal housing, and a fragmented infrastructure. Although gender differences may be important drivers of vulnerability, this study finds no significant differences in gender understanding or responses to pluvial flood risk in Ijebu-Ode, which suggests that precarity and other wider, deeper-rooted complex issues may be more important with (in)formal settlements.

Keywords*: Gender, Precarity, Inequality, Informal settlement, Flood risk perception, Natural hazards*

Introduction

Floods are one of the most common natural hazards, it is estimated that between 1900 and 2022 floods affected a total global population of more than four billion people and caused more than US$ 1650 billion in damages . The exposure of human settlements and critical assets to flood risk is increasing due to global climatic changes; e.g., sea level rise; changing precipitation patterns, intensities, and distributions; compounded by land use and land cover changes and urbanisation . This poses major challenges to sustainable development of linked natural and human systems. There have been notable recent global floods across continents, in particular in Asia 2022 , Africa 2022 , and Europe, 2021 , with significant impacts on lives, livelihoods, health and economic, physical, social and environmental assets, highlighting the increased need for effective management of flood risk, with this threat expected to increase with current global climate change (GCC) projections . Countries in Sub-Saharan Africa have been identified as some of the most susceptible to the impacts of GCC, despite having historically contributed relatively low emissions . Less than 3% of the total global greenhouse gas emissions originate from Sub-Saharan Africa; in comparison the top ten global emitters of greenhouse gases (e.g. Brazil, China, Canada, European Union, India, Indonesia, Japan, Mexico, Russia, and USA) are responsible for over 60% of all the total global emissions .

Floods are frequent and widespread hazards in Africa , particularly in sub-Saharan Africa (Douglas et al., 2008). On the average 500,000 people per year are affected by floods in West Africa alone (Jacobsen, Webster &Vairavamoorthy, 2012). Ndaruzaniye et al. (2010) identify that cumulatively in recent decades floods and droughts alone are responsible for around 80% of disaster-related deaths and 70% of economic losses in sub-Saharan Africa. In sub-Saharan Africa alone, 654 floods have affected 38 million people with around 13,000 deaths recorded (1980-2013; Tiepolo, 2014); demonstrating the urgent need to seek an effective solution to mitigate flood risk in the context of adaptation to climate change. Understanding risk perception is crucial for managing flood risk (Lechowska 2018), and

assessing community resilience and preparedness, although the relationship between public perceptions of risk and actions are complex, contextual, and influenced by a variety of factors (Odiase, Wilkinson, and Neef, 2020). Understanding precarity and power relations is critical for assessing social vulnerability . Precarity draws attention to politically induced conditions in which populations suffer from failing social and economic networks resulting in them becoming "differentially exposed to injury, violence, and death" (Butler 2009, 25), providing essential context for hazard and subsequent disaster studies.

Risk perception refers to the subjective judgement of individuals and/or groups when asked to evaluate a hazard, often in the context of limited and uncertain information, with perception being influenced by a range of cognitive, socio-cultural, and experiential factors (Slovic 2000). Risk perception encompasses individual, community, and societal-level awareness and assessment of the likelihood of the occurrence of a hazard and its potential impacts (e.g. loss of life, injury, property damage, and disruption to livelihoods). However, as note, flood risk perception incorporates human behaviours, consciousness, and emotions concerning the hazard, whilst identifies flood risk perception to be a combination of risk -awareness, -worry and -preparedness. Incorporating flood risk perception is necessary for effective flood risk management, as such an understanding of public risk perception is required, and the possible behaviour of that public in the event of a flood. However,) notes that perceived flood risk (by the individual or society) often fails to match that presented by experts, with flood risk often underestimated which can make flood risk management challenging.

The aim of this paper is to explore the relationship between flood risk perception, precarity, and gender in an (in)formal settlement. The factors driving flood risk perception are cognitive but also situational, and gender is one of the many demographic factors that influence risk perception (Lechowska 2018). This is particularly significant as women have been shown to interact with water resources and landscapes in different ways (Ajibade et al., 2013), with little research undertaken to address this issue (Baker et al., 2015). Previous research has identified a gap in the context of risk perception such that, when aware of the risk, women tend to perceive environmental and hydrological risks more acutely than men (Lindel & Hwang, 2008; McCright, 2010), although this is not always the case (Greenberg & Schnider, 1995). In general, women appear to take increased preventative action to mitigate against risk; however, this propensity towards protection does not always appear to translate into the domain of flood-related preparedness behaviours; for example, Bradford et al. (2012) and Scolobig et al. (2012), both find males reporting higher flood preparedness levels than females in European contexts. Such an understanding of gendered differences in perceived flooding risk, can be a powerful tool in targeting flood risk messaging and management , but a lack of understanding exists for African contexts. Furthermore, fundamental to the understanding of disasters, and therefore critical in maximising disaster risk reduction (DRR) strategies to their full potential, is that disasters are experienced differently based on individual characteristics, such as gender .

argued that women and children were the 'forgotten casualties' in disasters and has recently reiterated this argument , suggesting that the situation has worsened in the intervening years as a result of greater inequalities, with a continuing need for focused attention. As note, recognising differences in gender vulnerabilities in flood disasters is important, but also to understand their specific capacities is crucial. Women's experience and position in many African society's often equips them to better lead community and national climate risk adaptation approaches; reiterating the argument made by Dr. Farkhonda Hassan (Chair of the UN Economic Commission for Africa's Committee on Women and Development)"We are all aware that despite achievements and progress made, African women face major challenges and obstacles… [as the] majority of African women are still denied education and employment, and have limited opportunities in trade, industry and government" (Mutume, 2005). This supports the argument made by that greater awareness and engagement with gender was required in mitigating climate change impacts. Despite these calls, to date there have been few studies exploring the role of gender in flood perception and management in Africa, exceptions being and . Differentiated gender power relations between men and women and unequal access to, and control over assets, often means that inequalities exist that result in unequal adaptive capacity. Instead, women are characterized by distinct vulnerability and exposure to risk (AfDB, 2011). However, they are endowed with strong coping capacities in the face of climate change and can play an active role in adapting to its impacts (AfDB, 2011). As Gill (2014) notes climate change responses will have a gendered impact if gender is not considered in their design and implementation.

Inequalities in risk perception are exacerbated in situations of high vulnerability, which describes many communities across Africa.Climate change impacts communities in different ways and the consequences of such disasters will be felt unequally

.Inequalities arise due to spatial variations in, but are also experienced differently depending on demographics, including gender . Climate change has specific effects on women because of the different roles they often play in society and their differentiated access to social, economic and physical resources . In Africa, these disparities result in part from the social positions of women within the family and the community and are often exacerbated by the effects of climate change on access to food, clean water, safe sanitation, and energy supply (African Development Bank, 2009, p. 1). Vulnerability and the capacity to adapt is influenced by many other factors beyond gender, such as economic status, technology, health, education, information, skills, infrastructure, access to assets, and management capabilities . Many urban communities also live in precarious conditions, partly due to socio-economic factors such as poverty and marginalisation (, unemployment or/and inconsistent employment, relative high mortality and poor health . Rapid urban expansion without adequate planning or infrastructure in flood-prone areas has also made conurbations in Sub-Saharan Africa more vulnerable , especially in informal settlements where infrastructure, structures, and building materials are less resilient to flooding . All of this means that African countries require tailored mitigation and adaptation policies (Nyiwul 2021). However, overall adaptive capacity in Africa is considered low, with most adaptations remaining autonomous and reactive to short-term motivations (Niang et al., 2014).

Despite international efforts to reduce the loss of life, exposure to and damage from hazards (i.e. biological, geophysical, hydrological and meteorological hazards), the number of recorded disasters has continued to rise on a global-scale . The United Nations Office for Disaster Risk Reduction (UNDRR) plays an important role in coordinating the UN disaster reduction programmes, bringing together local, national, and international governments, partners, and communities to reduce disaster risk and losses to ensure a safe and sustainable future for all. The Sendai Framework for Disaster Risk Reduction 2015-2030 (Sendai), is endorsed and monitored by the UNDRR, is the guiding international policy structure for DRR strategies globally and nationally, with signatories to the framework required to report on their progress in implementing the framework. Sendai seeks to reduce disaster risk through the implementation of integrated and inclusive measures that prevent and reduce hazard exposure and vulnerability to disasters, increase preparedness for response and recovery, and thus strengthen individual and community resilience. Sendai was one of three landmark agreements that was adopted by the United Nations in 2015: the other two post-2015 global sustainable development agendas being, the Agenda 2030 Sustainable Development Goals (SDGs) and, under the auspices of the 'United Nations Framework Agreement on Climate Change' (UNFCC), the COP21 Paris Climate Change Agreement (Paris Agreement) . Despite each of these agreements differing in structure, legal context, and their implementation mechanisms, they all acknowledge the strong need for coordination and action on DRR, with greater coherence and alignment between them of policy goals and targets. There are a number of cross-cutting themes and shared priorities that run across a range of these global frameworks, the reduction of gender inequality being one of them; the importance of this priority is reflected in the inclusion of a separate goal on gender equality in the SDGs (SDG 5) that outlines six targets and three means of implementation, highlighting the need for continued action on empowering women and girls in order to achieve inclusive sustainable development .

This paper contributes to current discussions about the challenges and issues involved in untangling inequality, gender and precarity within the context of flood risk. The focus is on a mixed (in)formal settlement in West Africa; a conurbation similar to many that have suffered from pluvial flooding, with a range of socio-economic factors and drivers. Understanding how existing inequalities influence flood risk perception levels and implications for policy making is crucial.

Flood Risk in Ijebu-Ode (Nigeria)

Nigeria has a tropical climate with two precipitation regimes: low precipitation in the North (shortgrass and marginal savanna) and high precipitation in parts of the Southwest and Southeast (rainforest and mangrove). This can lead to aridity, persistent drought and desertification in the north; and erosion and large-scale flooding in the south (Akande et al., 2017; Nkechi et al., 2016). Ijebu-Ode, one of the 20 Local Government Areas (LGA) that makes up Ogun State (one of the 36 states) in Nigeria is used as a case study (Figure 1). Ijebu-Ode with a formal population of 154,032 (2006 census) has a population density of 1,139 per km2; with an elevation of 74 m.a.s.l. and total area cover of 192 km2,situated in southwestern Nigeria.

Figure 1: Location of Ijebu-Ode, districts and sampling locations in Ogun State, Nigeria. Districts: A) Irewon; B) Molipa Express; C) Molipa Road/Degun; D) Ibadan Road/Bonojo; E) Igbeba Road; F) Folagbade/NEPA; G) Yidi/Paramount/Sakasiru; H) Abeokuta; I) Local Government; J) Sabo; K) Adefisan.

The climate of Ijebu-Ode is characterised by southwestern Nigeria lowland tropical rain forest with distinct wet and dry seasons. The region on an annual basis is under the influence of hot-wet tropical maritime air mass during rainy season (April-October) and hot-dry tropical continental air mass during dry season (November-March; Figure 2). Rainfall is generally intense with peaks occurring in July and September (double maxima) coupled with high temperature, evapotranspiration and relative humidity. Fasona et al. (2010) indicated that apart from large scale process that influence the pattern of climate in Nigeria, the climate is also conditioned by several meso and local scale factors. The town being of low latitude is liable to flooding during the raining seasons (Aiyewunmi, 2023). Flooding is common and usually experienced during the raining seasons in Ijebu-Ode with heavy rainfall, poor drainage systems usually resulting in severe floods (Aiyewunmi, 2023). When rain is very heavy, most of the drainage channels overflow thereby severely affecting the people.

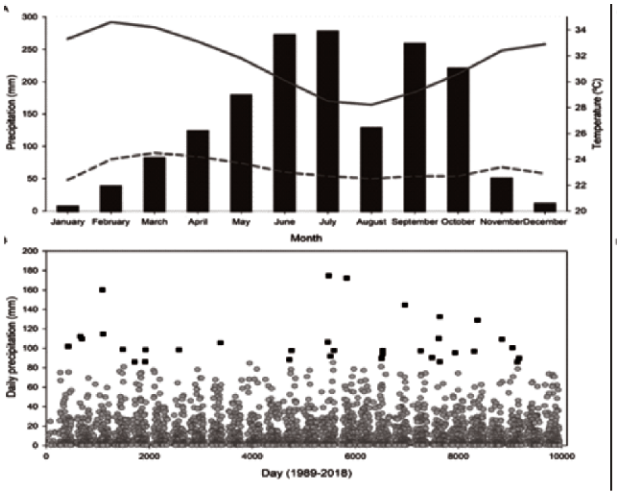

Figure 2: Average monthly maximum (solid red) and minimum (dashed red) temperature (°C) and precipitation (mm) for Ijebu-Ode, Nigeria (1989-2018).

The city is the third largest urban centre in Ogun State in terms of infrastructural facilities. Ijebu-Ode is an administrative headquarters and commercial centre which predates the colonial period. Historically, Ijebu-Ode is an ancient city situated in an inland area, which is centrally located in relation to the other human settlements nearby; several smaller towns and villages mostly referred to as Egure "this way to"; including towns such as Ogbo, Ijagun, Ala, Ososa, Erunwon, Ogbogbo, Isonyin, and Imoru. Ijebu-Ode consists of three districts: Iwade, Ijasi and Porogun and is the commercial centre of the Ijebu geopolitical area of Ogun State, Southwest Nigeria and has expanded rapidly during the last two decades. Studies on flood risk perception in Nigeria have been limited with a focus on fluvial floods and often the capital Lagos (Belcore et al., 2020). Despite the scale and impact of flooding across Nigeria, to date, with notable floods in 1933, 1948, 1963, 1978, 1980, 1982, 1985, 1987, 1988, 1990, 1999, 2000, 2001, 2005, 2006, 2010, 2011, 2012, 2013, 2017, 2020, 2022 the focus has been on fluvial flood events often associated with the River Niger and its tributaries; however, little attention has been given to pluvial flood risk. The high frequency of flood events in Nigeria in recent decades is key, as experiences of flooding are key in shaping perceptions of flood risk, but individuals responses towards risk explain inconsistencies between risk perception and response at spatial and temporal scales .

Current available flood risk information in Ijebu-Ode is restricted to qualitative sources such as the study of

newspapers and similar publications, which documented flood events, as there is no instrumental river flow data for the area as there are no river systems through the settlement. Information relating to past floods in Ijebu-Ode are not documented in official archives (detailed data on past flood damage or potential exposed items do not exist), however, relevant information pertaining to floods gathered by news agencies including interviews on flood extent and problems impacting the local population are available. Importantly these include information on the inhabitant's vulnerabilities and locations during different events, which were explored for the purpose of establishing impact of historical flooding on people of Ijebu-Ode. Recent floods in Ijebu-Ode have highlighted the threat that climate change presents to the people and communities, yet there is little evidence of any change in the frequency of intense precipitation events in Ijebu-Ode (Figure 2b), as such changes in flood risk may be a function of changing landcover and use.The drainage system constructed in Ijebu-Ode to serve a small population in the past, has failed to expand and develop despite rapid urbanization, settlement expansion and development witnessed in recent years, the result is a system that is of insufficient size or design capacity for current needs. The lack of waste infrastructure within the settlements means that waste is often placed into the public environment or streets (Figure 2), exacerbating the threat presented by flooding. Urban environments in Nigeria face a myriad of issues regarding poor drainage systems (Offiong et al., 2009), with urban flooding resulting in inundation of land and/or property with rainfall overwhelming the capacity of drainage systems (Tucci, 2001).

Research Questions

1. How does the perception of flood risk, state of precarity, and gender intersect with the accessibility of information about participant information, home area information, aspect of education and flood risk?
2. How does the perception of flood risk, state of precarity, and gender intersect with the accessibility of information about flood-related issues and emergency response strategies in Ijebu-Ode?
3. How does the perception of flood risk, state of precarity, and gender intersect with the accessibility of information about flood-related issues and emergency response strategies in Ijebu-Ode?

Methods

To understand individual perspectives of flood risk and how socio-cultural aspects shape flood risk awareness and behaviour in Ijebu-Ode, we designed and distributed a questionnaire (comprising of a range of 'open' and 'closed' questions, including a series of 5-point Likert scale questions), designed with five sections (1: Participant information; 2: Home area information; 3: Flood risk indicators; 4: Resilience indicators; 5. Mitigation). Copies of the questionnaire were distributed between April-July 2020 during different times of the day (all during daylight) within the 10 different communities in person on the street to capture a range of groups (Yidi/paramount/Sakasiru, Folagbade/Nepa, Irewon, Ibadan Road/Bonojo, Molipa Express, Ibgeba, Molipa Road/Degun, Adefisan, Abeokuta Road/New Road, Sabo). These communities were selected based on newspaper reports and personal experience of past flooding. Face-to-face surveys have also been identified as having high response rates and support can be offered to respondents where issues arise, such as poor literacy . In determining the sample size, the population of Ijebu-Ode is approximately 355,000, a 90% confidence interval on the derived results with a margin of error at 5% would require an ideal sample of 273, therefore a sample of 300 completed questionnaires was targeted which is comparable to previous studies in examining flood impacts on communities. In total, 299 completed questionnaires were returned across the study area.The analysis focused on descriptive statistics, with multiple combinations of responses considered through the use of pivot tables, correlation analysis (Pearson) with thematic content analysis of the open-ended responses.

Results

Research Question 1: How does the perception of flood risk, state of precarity, and gender intersect with the accessibility of information about participant information, home area information, aspect of education and flood risk?

From the study, 141 respondents (47.2%) were identified as male and 157 as (52.5%) female, with 1 (0.3%) providing no response. The majority (98%) of participants sampled where between age 18-65 and therefore of working age (only those of the age of 18 were sampled). Occupations of the participants varied: public servants (27.1%), students (26.1%), traders (19.4%), business executives (14.4%), and 12% represented by others. The majority (62.9%) had a tertiary education, whilst the respondents with secondary (26.1%) and primary education (3.7%), with only 1.67% having no formal education. The majority live within private accommodation (68.6%), with a slightly higher proportion of male (F/M: 33.1/35.1%); however, this pattern is reversed when

considering public (23.8%; F/M: 14.7/9%) and government (7.0%; F/M: 4/3%) housing. In considering residence times, the majority of residents have been present between 6-15 years (26.5%) or 16-25 years (33.1%) and >25 years (23.4%), notably the proportion of F/M respondents in the 16–25-year group has the largest difference, with 20.9% of female and 12.2% male (Figure 3A). In exploring the perceived importance of education among respondents (Figure 3B) many felt this was effective to some degree, with the strongest responses recognising the importance of school at increasing awareness in flood risk education, with a slightly stronger response amongst F/M (3.51/3.24 average score). Throughout the five questions exploring aspects of education and flood risk, female respondent scores were slightly higher (on average 0.226 higher on the Likert scale), though not significant statistically, it suggests female respondents may perceive education to be more important.

Research Question 2: How does the perception of flood risk, state of precarity, and gender intersect with the accessibility of information about flood-related issues and emergency response strategies in Ijebu-Ode?

Respondents overwhelmingly (81.3%) stated they did not have a rescue or emergency flood response plan in their area (F/M:43.5/37.5%); interestingly those stating they had (16.4%), contained a higher proportion of male (9.0%) to female respondents (7.4%), which supports previous studies (e.g. . When asked about access to information on flood problems, 44.5% stated they had information (F/M: 22.7/21.7%) compared to 53.5% stating they had no information (F/M: 28.4/24.8%). The majority (53.7%) of respondents identified they had 'often' experienced flooding (F/M: 27.7/26.1%), with 43.1% of respondents (F/M: 20.62:22.5%) expecting to experience a flood. However, if responses are considered by proportion of respondents by gender, a different picture emerges as 51.7% of male respondents expect to experience a flood compared to only 36.6% of female respondents; of those 71.6% and 75.6% (F/M) have experienced flooding. Notably of those that responded 'No', to experiencing a flood, and 'No' to expecting a flood (32.9%) a higher proportion were female (19.64/13.3%), which when considered as proportion of responses by gender (34.8/30.47%). In considering the free text responses to 'Did you imagine or expect that this area would flood (Q19-21), those that responded 'No' typically comment on the existence of 'no river' or other physical landscape aspects (n=12) or 'existing drainage systems' (n=20). Those responding 'Yes' provide a broader range of comments, and many refer to blocked drains (including refuse), maintenance issues of roads and a lack of drains, or a combination of these. When floods occur, most respondents consider them to span between 1-5 (F/M: 22.5/14.6%) or 6-10 (F/M: 8.7/11.8%) days; however, there is variability in these experiences (Figure 3C), with some respondents reporting that they last >21 days (8.8%).

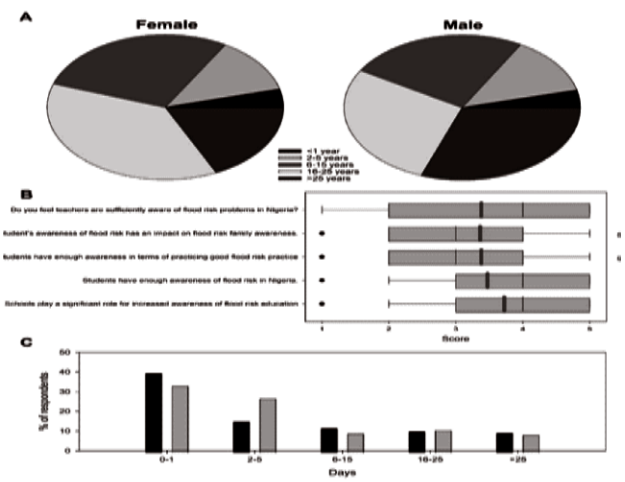

Figure3: A) Residence times in Ijebu-Ode for female (black)/male (grey) respondents; B) Responses to questions on education; C) Number of days respondents reported floods lasting.

Research Question 3: How does the perception of flood risk, state of precarity, and gender intersect with the accessibility of information about the causes of flooding and coping response strategies in Ijebu-Ode?

In considering the causes of flooding in Ijebu-Ode, a range of different ideas emerge from the respondents. Whilst the most popular is drainage (Figure 4A), the other words included are interesting. Some focus on the cause – either rainfall or blockages, but many focus on impacts or perceived responsibilities. In considering flood insurance, those with insurance (18.10%; F/M: 11/7.1%) is a much smaller proportion than those without (78.5%; F/M: 43.9/34.5%), with no notable difference when respondent response rates by gender are considered (F/M: 77.9/79.3%). Of those that have experienced flooding only 4.4% had insurance, with the main explanations given being unavailable and/or unable to afford it. In considering flood mitigation in the future, the majority believe that flood risk is achievable in Ijebu-Ode (64.1%; F/M: 37.5/26.6%), however 32.5% believe it unachievable. Those who considered flood risk to be unachievable in Ijebu-Ode provided a range of different free text responses, though most focused-on government inaction/funding, drainage or governance aspects (Figure 4B).

Figure 4: Word cloud generated from free test responses, A) Causes of flooding in your area; B) where respondents stated 'No' to 'Do you think flood risk management is achievable in Ijebu-Ode?

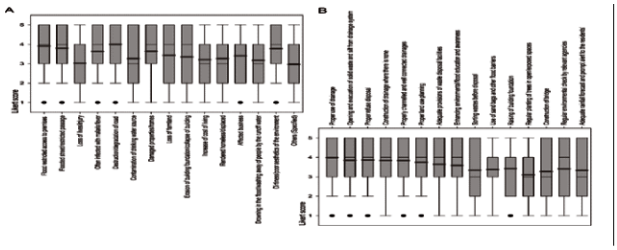

Figure 5: Survey responses. A) Respondents' awareness of the effects of flood disasters in Ijebu Ode; B) Respondents' perspective of the effectiveness of flood control. The Likert scale provides a 5-1 scaling, with respondent's selection either - 5A) Very severe; Severe; Not too severe; Not severe; Not so severe respectively, or 5B) Highly effective; Effective; Minimally effective; Not effective; Not effective at all respectively

Research Question 4: How does the perception of flood risk, state of precarity, and gender intersect with the accessibility of information about resilience to flooding and external support response strategies in Ijebu-Ode?

Overall, in considering resilience to flooding, respondents identified, 'clearance of drainage' (44.82%) and 'sand filling' (30.43%) clear preferences. However, in Figure B, respondents specifically identified several measures which include proper use of drainage, opening and evacuation of solid waste and silt from drainage system, proper refuse disposal, properly channelled and well-constructed drainage, proper land, planning including raising building foundations and resource management by government were the main elements raised by respondents as requiring action. Lower scores were received for education (Figure 5B). In considering government support, most (78.8%) stated their area did not receive support, with a similar proportion (79.6%) also stating they had no flood insurance; interestingly 49.8% stated they were prepared for flooding, compared to 34.1% stating not (F/M: 17.7/16.4%). There was relatively little support sought from family and friends (66.81%; F/M: 33.4/33.5%) or religious organisations (76.9%; F/M:42.2/34.6%), but where it was, higher support was attained by female than males from family and friends (F/M:20.5/9.5%), whilst religious support was lower (F/M: 11.7/8.3%). In considering the main impacts and concerns related to flooding, these predominantly focused on roads and properties being flooded, often infected with malaria, affected business including dirtiness/poor aesthetics of the environment, however loss of life was a relatively low concern (Figure 5A).

Discussion

The results demonstrate that a range of individuals with different characteristics, awareness and behaviours were captured by the survey. In exploring flood risk in Ijebu-Ode, it is evident that a range of issues and concerns are identified. It is also notable that the ideas of flood risk are poorly understood by some; for example, whilst Ijebu-Ode has no river system, 15.2% responded they live near/close to a river. This may suggest a lack of awareness of the absence of river systems or reflect a broader, less scientific understanding of what constitutes a river, with those responding positively in relation to proximity to a river including drains or drainage system within their understanding, which illustrates the challenges in the potential for misunderstandings. However, the questionnaire demonstrates that respondents recognise the challenges that flooding poses to their community, but that they also recognise that the challenges may likely extend beyond their individual capacity and require a more regional approach and solution (Figure 5).

Despite the emphasis on the need for gender-responsive DRR, including flood risk management, researchers did not identify significant statistical differences between female and male respondents. This suggests that issues of flooding in Ijebu Ode are more complex and multifaceted than to be simply defined by gender alone. Taking into consideration the multi-dimensional construction of social vulnerability (e.g. demographic attributes, social class, gender, etc.) is a critical factor in understanding its temporal, spatial and situational dimensions, as , p.127-128) notes "[…] people are not born vulnerable, they are made vulnerable […] different axes of inequality combine and interact to form systems of oppression – systems that relate directly to differential levels of social vulnerability, both in

normal times and in the context of disaster".

The results suggest that precarity, rather than gender, may be a critical challenge in Ijebu-Ode. Evidence of this can be seen through the responses, e.g. in recognising issues with governance and finance (insurance) or flood risk mitigation opportunities. In understanding the nature of the different groups within the respondents, we can attempt to identify those living within informal housing based on responses. A direct question exploring whether respondents resided within (in)formal housing was avoided, as it would likely be answered incorrectly/ignored or viewed with suspicion, as such we can use responses from other questions to approximate the contribution from those residing in informal housing, based on experiences of the community. Informal housing in Ijebu-Ode (and more widely in West Africa) is often constructed as single story (bungalow), made of brick or blocks, with residents considering themselves to reside in 'private' housing. These responses suggest that approximately 17-25% of respondents may be currently residing in informal housing in Ijebu-Ode; but direct observation of the communities suggests that this value is an underestimation, with a visual estimate being closer to 50%, suggesting a relatively high level of precarity within the community. The potential implications of such a relatively high level of variability between estimated (in)formal housing raises interesting questions as to how such differences may influence risk perception, preparedness and behaviour. As noted by , individual preparedness may be characterised as storing basic need items e.g. food, water, and essential items; however when living in a precarious state such items are often not in sufficient supply that stores can be made, and therefore they may be incapable of 'preparedness'. However as notes, natural hazards are a marginal concern when faced with precarity; but care must be taken to also recognise that diversity exists amongst such groups, and therefore they are not homogenous, with a variety of attributes . Within this study we have been unable to explore this question the degree of homogeneity and diversity, or explore the attributes of these communities, as such further work is required in unpacking these aspects of informal settlements.

In discussing flood risk understanding and perception, it is important to recognise differences in gender vulnerabilities, but also to understand specific individual/community capacities and how they intersect and interact with each other. Within the context of flooding, female respondents are often perceived to view flood risk more acutely than their male counterparts ; however, given the very high awareness of individuals who have experienced flooding, our study does not support any gender-based distinction (F/M 71.6/75.6%).Importantly, 51.7% of male respondents had experienced flooding (F 36.6%) suggesting that male population members are living in high-risk areas and aware of that risk, such experiential differences can have important implications for future flood risk perception and responses during flood events. This study however fails to determine whether this population accept the risk or whether they are in a position where they are unable to individually address it. When the age structure is considered then 69% of those in high-risk areas are aged between 26-55, with most (30.7%) between 36-45. Understanding such differences may represent a specific target audience for future risk reduction strategies. The low uptake of insurance (21.5%) with no significant gender difference suggests that either it is too costly, is unavailable or perceived to be unnecessary, with free text responses reflecting all these themes, whilst others thought flood risk management to be a government responsibility. The low uptake of insurance supports arguments that those living in precarious states is higher than originally estimated (17-25%), further supporting the argument that the proportion of the population living in informal housing may be closer to 50%, which would support a visual assessment of the communities.

A common theme that emerges within the responses relates to waste, and specifically the collection and disposal of waste into the drainage channels in Ijebu-Ode. Where an absence of communal waste collection is available, or private refuse collectors are not viable (either because of lack of community cohesion or because such services are not affordable), materials are often discarded locally or burnt. These findings echo those of previous studies (Onibokun and Kumuyi 1999; Olaseha and Sridhar 2004). Ijebu-Ode lacks a regular formal waste collection service, as such waste is often disposed of locally, with many identifying drainage channels as opportune locations, similar experiences were identified by Odjugo and Uriri (2011) in Benin-City. The result is that when drainage channels are filled with flood waters the waste materials are washed into public spaces and homes, exacerbating the health implications of the floods.

In considering support mechanisms post-flood event, this study found low levels of perceived support provided by religious bodies/organisations or family and or friends. Although these support mechanisms during disasters are important and have been widely discussed .This was not notable among the survey respondents in Ijebu-Ode. A potential explanation for this difference compared to previous studies focused on North America/Europe arises from cultural perspectives of accepting support from others

(charity) and suspicions as to what is required in return, but also concerns that they would lose 'their land'. Multiple respondents raised concerns in relation to governance, this spans several aspects, including land tenure/ownership, poor regional/central governance, perceptions of corrupt government, long-term inconstancies in government policy and 'policy somersault' resulting in poor awareness and trust, as such poor levels of trust hamper community engagement and development.

The approach to flooding in Ijebu-Ode is one focused on response and recovery rather than resilience building, with identifying similar limitations in relation to flooding in Malawi. In exploring the challenge of pluvial flood risk in Ijebu-Ode, many of the respondents see flood management and mitigation as a government responsibility, however, those same responses realize that local activities might be useful, such as local clearing drainage channels of debris or excavating local channels.Supporting individual actions within the context of broader governmental support reflects the shift towards a 'shared responsibility' as outlined within the Sendai Framework for DRR and discussed recently more broadly . However, the literature is dominated by case studies from high income countries with well-resourced with well-defined DRR governance regimes (e.g. French, Australian and USA) relative to that of Nigeria. The lack of studies in the literature concerning informal settlements and the availability of African case studies underscores the need for more investment in understanding how these challenges play out – and how they can be overcome – in countries where gender, precarity, and other complex socio-economic issues exacerbate flood risk and vulnerability.

The challenges of flooding crosses many of the UN SDGs, in particular, SDG's 1 (No Poverty), 2 (Zero Hunger), 3 (Good Health and Well-Being), 4 (Quality Education), 5 (Gender Equality), 6 (Clean Water and Sanitation), 8 (Decent Work and Economic Growth), 11 (Sustainable Cities and Communities), 13 (Climate Action), 14 (Life Below Water), and 15 (Life on Land). Opportunities exist for targeting knowledge improvement towards children, the other 'forgotten casualty' of disasters , building understanding and perceptions of flood risk can have significant long term and multigenerational benefits, with little work having been undertaken within an African setting to date such concepts. In considering the respondents of Ijebu-Ode, role of education in reducing future risk was acknowledged, whilst a lack of education was given as a reason as to why flood risk management was unachievable, as such considerable opportunities are available to improve flood risk education in Ijebu-Ode.

identify that whilst advancements are taking place in raising women's role in relation to climate change policy, it varies considerably from country to country. To translate flood risks into human development terms, we need to assess the specific and differential ways in which they affect women and men within these systems.The European Institute for Gender equality reported that women are, on average, more concerned about the environment and climate change, but are still influenced by a set of gender inequalities. Gender equality does not mean that women and men will become the same, but rather implies equal treatment of women and men in laws and policies, and equal access to resources and services within families, communities, and the society at large . This is crucial moving forward as government and relevant authorities, especially at grassroot levels, should seek to engage with both male and female (i.e., take advantage of "mixed-gender" physical and non-physical behaviour), with a view to balancing and enhancing their flood risk resilience and increasing household participation. There is urgent need for a new policy formulation and implementation that will balance tradition and fundamental human rights, that reduces vulnerability and exposure to climate risk for all.

Conclusion

Our findings suggest that gender differences are not evident within the responses received in Ijebu-Ode in relation to flood risk understanding and perception. This may be partly a function of the sample, with men being more likely to experience flooding or live in flood prone areas, but it also points to the importance of looking beyond gender to complex, often precarious socio-economic situations. Adaptive and response capacities for flood risk are low when considering the everyday challenges and priorities for those living in precarious states, as demonstrated by low levels of insurance and relatively low priority assigned to education in this study. Traditional roles, reduced opportunities, and greater employment insecurities may negatively impact flood risk perception against a backdrop of precariousness for many. Differentiated gender power relations and socioeconomic status mean that men and women may not have the same adaptive capacity, however this research suggests that for those marginalised and vulnerable, living with persistent precarity are not differentiated by gender when considering flood risk in Ijebu-Ode. Previous research has recognized that women's experience and the strategic position in society equips them with the potential to lead efforts at community and national levels, however this may not be realised because of policy deficiencies .This is reflected in Ijebu-Ode, as the absence of government

action or capacity limits opportunities for flood risk reduction, but future programmes can build on opportunities identified, particularly education. When considering climate change – and specifically flood risk – from a gender equality perspective, the low participation of women in policy and decision-making traditionally in Nigeria and Ijebu-Ode should be addressed, engendering more effective and inclusive policies. However, opportunities to engender greater equality in future flood risk reduction are hampered by the socio-economic context, but flood risk reduction practices need to recognise, engage and incorporate cultural and behavioural practices. Moving forward greater understanding of informal settlements and their capacity to adapt to hazards is required, recognising the plurality of those living with such communities, with opportunities to further explore the significance of cultural practices and behaviours in flood risk understanding and ways in which such information could be embedded into flood risk management as local knowledges.

Acknowledgements

I would like to express my gratitude to the Federal Government of Nigeria, through the Tertiary Education Trust Fund (tetfund), and Tai Solarin College of Education, Omu-Ijebu, for funding the research on which this paper is based (studentship grants TETF/DASTD/COE/OMUIJEBU/ASTD/2017/VOL.1 and TASCE/T/SSF/152/043) at the University of Liverpool.

Disclosure Statement

The authors report there are no competing interests to declare.

References

Aiyewunmi, Temitope (2023) Challenges and potential solutions to pluvial flood risk in urban tropical African communities, a case study using Ijebu-Ode, in South West Nigeria. Doctor of Philosophy thesis, University of Liverpool.

Ajibade, I., McBean, G., & Bezner-Kerr, R. (2013). Urban flooding in Lagos, Nigeria: Patterns of vulnerability and resilience among women. Global Environmental Change, 23(6), 1714–1725. https://doi.org/10.1016/J.GLOENVCHA.2013.08.009

Amoako, C., & Inkoom, D. K. B. (2018). The production of flood vulnerability in Accra, Ghana: Re-thinking flooding and informal urbanisation. Urban Studies, 55(13), 2903–2922. https://doi.org/10.1177/0042098016686526

Andrijevic, M., Crespo Cuaresma, J., Lissner, T., Thomas, A., & Schleussner, C. F. (2020). Overcoming gender inequality for climate resilient development. Nature Communications 2020 11:1, 11(1), 1–8. https://doi.org/10.1038/s41467-020-19856-w

Antronico, L., Coscarelli, R., Gariano, S. L., & Salvati, P. (2023). Perception of climate change and geo-hydrological risk among high-school students: A local-scale study in Italy. International Journal of Disaster Risk Reduction, 90, 103663. https://doi.org/10.1016/J.IJDRR.2023.103663

Belcore, E., Pezzoli, A., & Calvo, A. (2020). Analysis of gender vulnerability to climate-related hazards in a rural area of Ethiopia. The Geographical Journal, 186(2), 156–170. https://doi.org/10.1111/GEOJ.12321

Bob, U., & Babugura, A. (2014). Contextualising and conceptualising gender and climate change in Africa. Https://Doi.Org/10.1080/10130950.2014.958907, 28(3), 3–15. https://doi.org/10.1080/10130950.2014.958907

Bradford, R. A., O'Sullivan, J. J., Van Der Craats, I. M., Krywkow, J., Rotko, P., Aaltonen, J., Bonaiuto, M., De Dominicis, S., Waylen, K., & Schelfaut, K. (2012). Risk perception – issues for flood management in Europe. Natural Hazards and Earth System Sciences, 12(7), 2299–2309. https://doi.org/10.5194/NHESS-12-2299-2012

Butler, J (2009): Frames of War: When is Life Grievable? London: Verso

Carone, M. T., & Marincioni, F. (2020). From tale to reality: Geographical differences in children's flood-risk perception. Area, 52(1), 116–125. https://doi.org/10.1111/AREA.12552

Cornwall, W. (2021). Europe's deadly floods leave scientists stunned despite improvements, flood forecasts sometimes failed to flag risks along smaller streams. Science, 373(6553), 372–373. https://doi.org/10.1126/SCIENCE.373.6553.372/ASSET/FF38E2C6-8279-4A40-82B4-54D1B7E4725B/ASSETS/GRAPHIC/373_372_F1.JPEG

Coronese, M., Lamperti, F., Keller, K., Chiaromonte, F., & Roventini, A. (2019). Evidence for sharp increase in the economic damages of extreme natural disasters. Proceedings of the National Academy of Sciences of the United States of America, 116(43), 21450–21455 https://doi.org/10.1073/PNAS.1907826116/SUPPL_FILE/PNAS.1907826116...

Crosweller, M., & Tschakert, P. (2021). Disaster management and the need for a reinstated social contract of shared responsibility. International Journal of Disaster Risk Reduction, 63, 102440. https://doi.org/10.1016/j.ijdrr.2021.102440

Cutter, S. L. (1995). The forgotten casualties: women,

children, and environmental change. Global Environmental Change, 5(3), 181–194. https://doi.org/10.1016/0959-3780(95)00046-Q

Cutter, S. L. (2017). The forgotten casualties redux: Women, children, and disaster risk. Global Environmental Change, 42, 117–121. https://doi.org/10.1016/J.GLOENVCHA.2016.12.010

de Vaus, D. (2014). Surveys in Social Research (Sosial Research Today). Taylor & Francis Ltd. https://www.routledge.com/Surveys-In-Social-Research/Vaus-Vaus/p/book/9780415530187

Di Baldassarre, G., Montanari, A., Lins, H., Koutsoyiannis, D., Brandimarte, L., & Blschl, G. (2010). Flood fatalities in Africa: From diagnosis to mitigation. Geophysical Research Letters, 37(22). https://doi.org/10.1029/2010GL045467

Douglas, I., (2017): Flooding in African cities, scales of causes, teleconnections, risks, vulnerability and impacts. International Journal of Disaster Risk Reduction, 26, pp. 34–42.

Duží, B., Vikhrov, D., Kelman, I., Stojanov, R., & Juřička, D. (2017). Household measures for river flood risk reduction in the Czech Republic. Journal of Flood Risk Management, 10(2), 253–266. https://doi.org/10.1111/JFR3.12132

EIGE. (2016). Gender in environment and climate change. https://eige.europa.eu/publications/gender-environment-and-climate-change

EM-DAT. (2022). The Emergency Events Database (D. Guha-Sapir (ed.)). EM-DAT?:The Emergency Events Database; Université catholique de Louvain (UCL) - CRED,. www.emdat.be

Gaillard, J. C., Walters, V., Rickerby, M., & Shi, Y. (2019). Persistent Precarity and the Disaster of Everyday Life: Homeless People's Experiences of Natural and Other Hazards. International Journal of Disaster Risk Science, 10(3), 332–342. https://doi.org/10.1007/S13753-019-00228-Y/METRICS

Grothmann, T., & Reusswig, F. (2006). People at risk of flooding: Why some residents take precautionary action while others do not. Natural Hazards, 38(1–2), 101–120. https://doi.org/10.1007/S11069-005-8604-6

Heerwegh, D., & Loosveldt, G. (2008). Face-to-Face versus Web Surveying in a High-Internet-Coverage PopulationDifferences in Response Quality. Public Opinion Quarterly, 72(5), 836–846. https://doi.org/10.1093/POQ/NFN045

Ho, M. C., Shaw, D., Lin, S., & Chiu, Y. C. (2008). How Do Disaster Characteristics Influence Risk Perception? Risk Analysis, 28(3), 635–643. https://doi.org/10.1111/J.1539-6924.2008.01040.X

IPCC. (2022a). AR6 Synthesis Report: Climate Change 2022 — IPCC. AR6 Synthesis Report: Climate Change 2022 — IPCC, 85. https://www.ipcc.ch/report/ar6/syr/

IPCC. (2022b). Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernamental Panel on Climate Change. https://doi.org/10.1017/9 781 009325844.Front

Jamil, H., Liaqat, A., Lareeb, I., Tariq, W., Jaykumar, V., Kumar, L., Tahir, M. J., Anjlee, F., Naseem Shah, S., & Asghar, M. S. (2023). Monsoon and cholera outbreaks in Pakistan: a public health concern during a climate catastrophe. International Journal of Surgery: Global Health, 6(1), e105–e105. https://doi.org/10.1097/GH9.0000000000000105

Jones, M. W., Peters, G. P., Gasser, T., Andrew, R. M., Schwingshackl, C., Gütschow, J., Houghton, R. A., Friedlingstein, P., Pongratz, J., & Le Quéré, C. (2023). National contributions to climate change due to historical emissions of carbon dioxide, methane, and nitrous oxide since 1850. Scientific Data 2023 10:1, 10(1), 1–23. https://doi.org/10.1038/s41597-023-02041-1

Jonkman, S. N., & Kelman, I. (2005). An analysis of the causes and circumstances of flood disaster deaths. Disasters, 29(1), 75–97. https://doi.org/10.1111/J.0361-3666.2005.00275.X

Kellens, W., Zaalberg, R., Neutens, T., Vanneuville, W., & De Maeyer, P. (2011). An Analysis of the Public Perception of Flood Risk on the Belgian Coast. Risk Analysis, 31(7), 1055–1068. https://doi.org/10.1111/J.1539-6924.2010.01571.X

Lindell, M. K., & Hwang, S. N. (2008). Households' Perceived Personal Risk and Responses in a Multihazard Environment. Risk Analysis, 28(2), 539–556. https://doi.org/10.1111/J.1539-6924.2008.01032.X

Mcdowell, G., Ford, J., & Jones, J. (2016). Community-level climate change vulnerability research: trends, progress, and future directions. Environmental Research Letters, 11(3), 033001. https://doi.org/10.1088/1748-9326/11/3/033001

Monteil, C., Foulquier, P., Defossez, S., Péroche, M., & Vinet, F. (2022). Rethinking the share of responsibilities in disaster preparedness to encourage individual preparedness for flash floods in urban areas. International Journal of Disaster Risk Reduction, 67, 102663. https://doi.org/10.1016/J.IJDRR.2021.102663

Nakash, R. A., Hutton, J. L., Jørstad-Stein, E. C.,

Gates, S., & Lamb, S. E. (2006). Maximising response to postal questionnaires--a systematic review of randomised trials in health research. BMC Medical Research Methodology, 6. https://doi.org/10.1186/1471-2288-6-5

Nelson, V., Meadows, K., Cannon, T., Morton, J., & Martin, A. (2010). Uncertain predictions, invisible impacts, and the need to mainstream gender in climate change adaptations. 10(2), 51–59. https://doi.org/10.1080/13552070215911

Neumayer, E., & Plümper, T. (2007). The gendered nature of natural disasters: the impact of catastrophic events on the gender gap in life expectancy, 1981–2002. Ann. Assoc. Am. Geogr., 97(3), 551–566. https://doi.org/10.1111/j.1467-8306.2007. 00563.x

Nhamo, G., & Nhamo, S. (2018). Gender and Geographical Balance: With a Focus on the UN Secretariat and the Intergovernmental Panel on Climate Change. Gender Questions, 5(1). https://doi.org/10.25159/2412-8457/2520

Odiase, O., Wilkinson, S., & Neef, A. (2020). Risk of a disaster: Risk knowledge, interpretation and resilience. Jamba: Journal of Disaster Risk Studies, 12(1), 1–9. https://doi.org/10.4102/JAMBA.V12I1.845

Pavageau, C., Locatelli, B., Sonwa, D., & Tiani, A. M. (2016). What drives the vulnerability of rural communities to climate variability? Consensus and diverging views in the Congo Basin. 10(1), 49–60. https://doi.org/10.1080/175 655 29.2016.1193460

Quinn, T., Heath, S., Adger, W. N., Abu, M., Butler, C., Codjoe, S. N. A., Horvath, C., Martinez-Juarez, P., Morrissey, K., Murphy, C., & Smith, R. (2023). Health and wellbeing implications of adaptation to flood risk. Ambio 2023, 1–11. https://doi.org/10.1007/S13280-023-01834-3

Raaijmakers, R., Krywkow, J., & van der Veen, A. (2008). Flood risk perceptions and spatial multi-criteria analysis: An exploratory research for hazard mitigation. Natural Hazards, 46(3), 307–322. https://doi.org/10.1007/S11069-007-9189-Z

Ramiaramanana, F. N., & Teller, J. (2021). Urbanization and Floods in Sub-Saharan Africa: Spatiotemporal Study and Analysis of Vulnerability Factors—Case of Antananarivo Agglomeration (Madagascar). Water 2021, Vol. 13, Page 149, 13(2), 149. https://doi.org/10.3390/W13020149

Richardson, R. C., Plummer, C. A., Barthelemy J.J., & Cain, D. S. (2009). Research after Natural Disasters: Recommendations and Lessons Learned. Journal of Community Engagement and Scholarship, 2, 3–11. https://books google.co.uk/books?hl=en&lr=&id=hC4pZZV wWRUC&oi=fnd&pg=PA3

Rufat, S., Fekete, A., Armaş, I., Hartmann, T., Kuhlicke, C., Prior, T., Thaler, T., & Wisner, B. (2020). Swimming alone? Why linking flood risk perception and behavior requires more than "it's the individual, stupid." WIREs Water. https://doi.org/10.1002/wat2.1462

Šakić Trogrlić, R., Duncan, M., Wright, G., van den Homberg, M., Adeloye, A., & Mwale, F. (2022). Why does community-based disaster risk reduction fail to learn from local knowledge? Experiences from Malawi. International Journal of Disaster Risk Reduction, 83. https://doi.org/10.1016/j.ijdrr.2022.103405

Satterthwaite, D., Archer, D., Colenbrander, S., Dodman, D., Hardoy, J., Mitlin, D., & Patel, S. (2020). Building Resilience to Climate Change in Informal Settlements. One Earth, 2(2), 143–156. https://doi.org/10.1016/J.ONEEAR.2020.02.002

Thompson, S. K. (2012). Sampling, Third Edition. Sampling, Third Edition. https://doi.org/10.1002/9781118162934

Tierney, K. J. (2019). Disasters: A Sociological Approach. Polity Press.

UN General Assembly. (2015). Transforming Our World: the 2030 Agenda for Sustainable Development | Department of Economic and Social Affairs. In United Nations. https://sdgs.un.org/publications/transforming-our-world-2030-agenda-sustainable-development-17981

UNFCC. (2015). Adoption of the Paris Agreement. In Conference of the Parties on its twenty-first session (Issue December). http://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf

UNHCR. (2022). Millions face harm from flooding across West and Central Africa, UNHR warns. UNHCR. https://www.unhcr.org/news/briefing-notes/millions-face-harm-flooding-across-west-and-central-africa-unhcr-warns

UNISDR. (2004). Disaster Risk Reduction for Sustainable Development in Africa.

Vickery, J. (2017). Using an intersectional approach to advance understanding of homeless persons' vulnerability to disaster. 4(1), 136–147. https://doi.org/10.1080/23251042.2017.1408549

Webber, R., & Jones, K. (2013). Rebuilding Communities After Natural Disasters: The 2009 Bushfires in Southeastern Australia. Http://Dx.Doi.Org/10.1080/01488376.2012.754196, 39(2), 253–268.

Wisner, B. (2004). At risk? natural hazards, people's vulnerability, and disasters. Routledge.

World Bank. (2018). World Development Indicators Data-Base. http://data.worldbank.org

World Meteorological Organization (WMO). (2022). State of the Climate in Africa 2021.

Zaidi, R. Z., & Fordham, M. (2021). The missing half of the Sendai framework: Gender and women in the implementation of global disaster risk reduction policy. Progress in Disaster Science, 10, 100170. https://doi.org/10.1016/j.pdisas.2021.100170