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'We are at the mercy of the floods!' : Extreme weather events, disrupted mobilities, and everyday navigation in urban Ghana

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This paper examines how extreme weather events affect the mobility of low-income urban residents in Ghana. Bringing together scholarship on extreme weather and mobilities, it explores the differential impact of flooding on their everyday lives as they navigate the cities of Accra and Tamale. A range of qualitative methods were drawn on, including semi-structured interviews, focus group discussions, and follow-along-participant observations in selected communities of both cities. Three key themes emerged: disrupted road and transport infrastructure, everyday mobility challenges, and coping/adaptive strategies. In flooding conditions, residents experienced difficulties leaving/returning home, engaging in income-generating activities, and accessing transport services and other key urban infrastructure. Conceptually, the paper reveals how disruption to urban residents' daily movements and activities (re)produces new forms of mobilities and immobilities, which have three relational elements: postponed, improvised and assisted. Throughout the analysis, we show how these mobilities/immobilities vary by age and gender: all urban residents, (though women in particular), experience *postponed mobility*; young people especially engage in *improvised mobility*; and children and the elderly are in greatest need of *assisted mobility*. The paper thus contributes to scholarship on extreme weather events and mobility by providing a more spatially nuanced understanding of the multi-faceted domains in which flooding, socio-economic conditions and adaptive strategies intersect to influence urban mobility in resource poor settings.

Keywords: extreme weather, flooding, everyday mobility, Accra, Tamale, Ghana

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Introduction

The impact of extreme weather events on urban populations and infrastructure in sub-Saharan Africa has started to gain attention in recent years (Gough *et al*., 2019; Kayaga *et al*., 2021; Wilby *et al*., 2021). This growing traction in scholarship reflects the rising international interest and societal response to climate change adaptation and mitigation in the context of sustainable development and equity issues (Smith & Pilifosova, 2001). Sustained mobility has long been part of social organization and lived experiences across cities in sub-Saharan Africa (Schraven *et al*., 2020). It is increasingly being recognized, however, that extreme weather and related shocks are inducing new waves and types of mobility (McMichael, 2020; Oakes, 2019). At the same time, vulnerable communities and populations are becoming less mobile due to limited financial, social and physical assets and networks (Akyelken, 2020; Cook & Butz, 2013). As research to date has focused on the most catastrophic weather events and accompanying damage to property and loss of life, greater knowledge is needed on how weather extremes affect the mobility and activities of low-income urban residents and how this varies across age, gender and location (Andreasen *et al*., 2022).

Focusing on flooding in urban Ghana, this paper provides new insight into how extreme weather events disrupt the everyday mobility of low-income residents and how this influences their daily activities as they navigate the city. Ghana is prone to floods, with devastating impacts especially on the urban poor (Amoako & Inkoom, 2018; Gough *et al.*, 2019). As flooding has become an annual occurrence, cascading flood disasters, which claim lives and disrupt mobility and critical infrastructure, are becoming increasingly common. In June 2015, a major flood and fire event in the capital city of Accra killed around 150 people; over 8000 were displaced, many were injured, and built structures to the value of millions of dollars were destroyed (UN Country Team Ghana, 2015). As flood events are predicted to become more frequent and severe due to climate change (IPCC, 2021), sustainable mobility practices are needed to enhance preparedness and minimize the impact and disruption of weather extremes.

In this paper, we frame disrupted mobility around three relational elements: postponed, improvized and assisted. Importantly, these elements have implications for time-(in)dependent activities and feelings of being immobile, stuck, trapped, idle and disconnected from the city. Throughout the analysis, we illustrate how these constituent elements emerge from the following themes: disrupted road and transport infrastructure, daily urban mobility challenges, and coping and adaptive strategies. Contextual factors, individual perceptions, values and mobility behaviour are shown to influence the extent to which mobility disruptions impact on residents' navigation of the city. In both Accra and Tamale, disrupted mobility produces and shapes these new forms of mobilities, which vary by age and gender. By drawing on this framework, we demonstrate that the links between extreme weather events and mobility are complex, defying simplistic logic whereby weather extremes necessarily trigger mobility. Depending on personal circumstances, social variables and environmental conditions, extreme weather events can result in greater or reduced mobility (Wiederkehr *et al.*, 2018).

The remainder of the paper is structured as follows. The subsequent section presents the conceptual framework, bringing into conversation concepts of mobility and extreme weather. This is followed by an overview of the settlements studied in Accra and Tamale, and the qualitative methodology used to collect and analyse data. Next, we discuss the empirical findings, highlighting how extreme weather conditions impact and disrupt people's mobilities and everyday activities as they navigate the city. The discussion is structured around the three key themes: disrupted roads and transport infrastructure; restrictions on everyday mobility and activities; and coping/adaptive strategies. The paper concludes that analysing urban residents' mobilities and participation in daily activities is key to understanding the potentially differential effects of extreme weather on how people navigate the city.

Mobility and extreme weather events

As the 'new mobilities paradigm' which emerged in the early 2000s highlights, it is important to examine the constitutive role of movement within social practices (Sheller & Urry, 2006; Sheller, 2021). Our paper is informed in particular by Cresswell's (2008; 2010) exploration of mobility as movement, representation and practice. He extends the concept of mobility to a broader 'practice mobility' that views mobility as significant within place-making and in shaping the experience, strategies and identities of those who move, as well as those who are rendered immobile

(Cresswell, 2012). These broader perspectives on mobility have informed research in the global South, including motivations for navigating between places in the city; whilst some urban residents travel between home and work on a daily commute, it is more usual for mobility to be an inherent element of income-generating activities, especially for low-income households (Amankwaa, 2017; Esson *et al*., 2016; Yankson *et al*., 2017). Through their mobility practices, poor urban residents forge and sustain social relations and 'navigate the interplay between personal hopes, social expectations, and the financial uncertainty associated with urban life' (Amankwaa *et al*., 2020: 2; see also Esson *et al*., 2021; Amankwaa & Gough, 2022). Such mobility practices are recognized as being highly gendered (Akyelken, 2020; Moller-Jensen, 2021), as well as influenced by age (Langevang & Gough, 2009; Wignall *et al*., 2019).

The literature on the extreme weather-mobility nexus has evolved rapidly in recent years (Berlemann & Steinhardt, 2017). While the dominant narrative portrays extreme weather conditions as a significant driver of migration, the empirical evidence paints a complex picture since mobility is also shaped by geographical, cultural, institutional, and socio-economic factors (Grecequet *et al*., 2017). To advance the literature, micro-level and context-specific studies examining the extreme weather-mobility nexus are particularly warranted. This is especially so in the context of sub-Saharan African countries where adapting to the impacts of extreme weather conditions is often more feasible and affordable compared with costly internal seasonal migration and international movements (Roeckert & Kraehnert, 2022).

Studies on the relationship between extreme weather and mobility have mainly focused on modeling, analysing and predicting the network performance of transportation systems in cities, including research on accidents, disruption, traffic speed and infrastructure maintenance costs (Heyndrickx *et al*., 2014; Jaroszweski *et al*., 2010). The impact of extreme weather on individual mobility and daily decisions regarding activities, destinations and travel modes has been under-investigated, although there are exceptions, especially in an Asian context. For example, Akyelken (2020) compellingly illustrates how floods in Metro Manila, Philippines are an everyday life risk for informal settlement residents, which has a pervasive impact on work-related mobility. In relation to extreme heat in Dhaka, Bangladesh, urban residents working in the city centre, which suffers from a marked urban heat island (UHI) effect, have been shown to experience the greatest exposure to heat (Yasumoto *et al*., 2019).

By bringing together the concepts of mobility and extreme weather, this paper illustrates how differing forms of mobilities emerge under particular kinds of weather conditions and patterns of daily activities. Examining mobilities opens up new ways of exploring how extreme weather conditions are negotiated, lived and experienced. Mobility studies have examined life lived 'on the move' and the ways in which social inequalities are exacerbated or recalibrated during emergencies and crises, including COVID-19 (Cresswell, 2008; Turner *et al*., 2021). While recognizing this, we contend that mobility studies should pay corresponding attention to life lived on the 'dormancy', whereby a segment of the population becomes less mobile, inactive, and even trapped by extreme weather events. This perspective brings to the fore the ways in which improvisation and adaptation influence existing (im)mobility patterns and practices, including at the level of embodied experience (Samuels, 2012). Consequently, in this paper, we use mobility as a lens to demonstrate and further the idea of 'disrupted movement', which provides a bridge between the disruption of everyday activities and people's experiences of negotiating, navigating and re-establishing their everyday lives within the urban terrain.

Our paper's framing of mobility and extreme weather is underpinned by three main rationale. First, the multi-faceted role of mobility within everyday practices and activities is emphasized. Countering the implicit assumption and simplistic account of how climate change triggers migration (climate mobilities) in sub-Saharan Africa, we extend the literature by drawing attention to the need for research to interrogate how people cope with the impacts of extreme weather events in their everyday lives and mobility practices. Second, how extreme weather events alter mobility needs is underscored. Our analysis provides insights into the channels and domains through which extreme weather events affect and shape mobility needs by illustrating the differing forms of (im)mobilities and considering the practices and strategies of poor urban residents whose everyday lives and livelihoods are directly affected by these events. Third, we highlight that climatic influences on mobility are not independent but are intricately connected with contextual factors, such as geography, economic circumstances, and social norms, which are not evenly distributed across location, gender and age. We contend that in most Ghanaian cities, a substantial proportion of the population has long used mobility as an integral element of their livelihoods or as a survival strategy and coping mechanism. Thus, we recognize that urban residents' economic means and intersecting identities (including gender and age) structure mobility outcomes, including the production of immobility and 'stuckness' (Thalheimer *et al.*, 2021).

Conceptually, our analysis is framed around three constituent elements that are relational. First, *postponed* mobility conveys urban residents' frustration when extreme weather renders them late or compels them to cancel their trip or daily activity pattern, which is compounded by loss of livelihoods and lack of access to infrastructure. Second, *improvised* mobility denotes how notwithstanding the multidimensional nature of constraints, residents innovatively create opportunities and forge strategies to navigate and overcome mobility disruption, activity restrictions and feelings of being left behind. Third, *assisted* mobility expresses how urban residents are aided in their mobility to navigate the city and access food or other basic necessities. Throughout the analysis, we show how these new forms of mobilities and immobilities vary by age and gender: all urban residents but women in particular experience *postponed mobility*, it is especially young people who engage in *improvised mobility*, and children and the elderly who are most in need of *assisted mobility*.

Study area and methodology

Since 2010, Ghana has registered more than half of its citizens as living in cities. At the current urbanization rate of 3.3 per cent, by 2030, an estimated 24 million people, representing 63.4 per cent of the population will be living in cities (UN, 2019). In order of size, Accra, Kumasi, Sekondi-Takoradi, and Tamale represent the four most urbanized areas of Ghana. Despite steady economic progress over the past two decades, Ghanaian cities have not benefited from the full potential dividends of urbanization. This is partly due to challenges associated with the current monocentric urban spatial structure, whereby important institutions and many formal income-generating activities are focused in the city centre, while most residents live in distant locations with poor transport infrastructure linking the two (Amankwaa *et al.*, 2022).

Accra and Tamale, located in the south and north of Ghana respectively, were selected as study cities due to their differing locations, sizes and climates. Accra is the capital and largest city in Ghana with an estimated population of 2.7 million in 2022, while Tamale is a rapidly growing intermediate-sized city with an estimated population

of just over 700 000 in 2022. Tamale experiences a tropical wet and dry climate with seasonal variations in temperature, ranging from an average of 25–27°C in the wet season to 27–32°C in the hot, dry season. In contrast, Accra experiences a hot semi-arid/tropical wet climate with average temperatures ranging from 22 to 25°C in the coolest season, and 25 to 28°C in the warmest period. In Accra, public transport trips are dominated by the informally operated paratransit minibuses (locally referred to as trotros), which account for three-quarters of urban vehicular journeys, with around 11 200 trotros operating on 315 routes. Half of all trips in Accra are made on foot but only 0.5 per cent of residents use bicycles, 1 per cent motorbikes, and 29 per cent private cars (TUMI, 2019). In Tamale by contrast, the dominant transport modes, alongside walking, are personal bicycles, motorbikes and motorized roofed three-wheelers, variously known as Mahama can-do, Yellow-Yellow, Motor-King or Pragia. The inefficient management of an already limited and deteriorated road infrastructure results in intractable traffic congestion, especially in Accra, and hence loss of productive hours. This situation is likely to continue in both cities making navigation time-consuming and expensive, which is exacerbated by extreme weather events.

Both cities have long suffered from severe flooding, including devastating events that have occurred in recent decades (Rain *et al*., 2011; Gough *et al*., 2019). In order to select the study settlements within the cities that are most prone to flooding, discussions were held with key stakeholders including city planners, service providers and community opinion leaders, and flood simulations were conducted using 2m topographic data to generate maps of predicted flood depth and extent. Based on these data and the authors' in-depth knowledge of Accra and Tamale, a total of eight study communities (four in each city) were studied[1] (see Table 1 and Figures 1 and 2). These settlements generally have high population densities and house low-income populations, in line with previous findings that poor urban settlements suffer most from severe flood events (Douglas *et al*., 2008; Amoako & Inkoom, 2018).

As part of the process of entering the communities, we informed community elders and opinion leaders of our desire to work closely with them through a representative referred to as a 'Champion'. Hence, for each study location, a community 'Champion' was selected by the elders/leaders as the person they believed best placed to support our research. These community Champions included: Assemblymen, unit committee

Table 1. Study settlements.

City	Settlement	Characteristics	Population (in 2010)
Accra	Agbogbloshie	Indigenous Ga settlement with dense infilling and busy informal market.	8305
	Alajo	Informal compound housing and large colonial-style dwellings divided into multi-family units.	44 044
	Odawna	Informal settlement located by Odaw river with many commercial activities including a busy market.	36 510
	Bortianor	Peri-urban indigenous coastal settlement with relatively low housing density.	32 485
Tamale	Kukuo	Densely populated informal community.	2807
	Lamashegu	Informal residential area including small industries.	19 733
	Gumani	Low lying linear settlement with primarily informal dwellings.	12 506
	Ward K	Centrally located informal community.	3986

Source: Authors' construct.

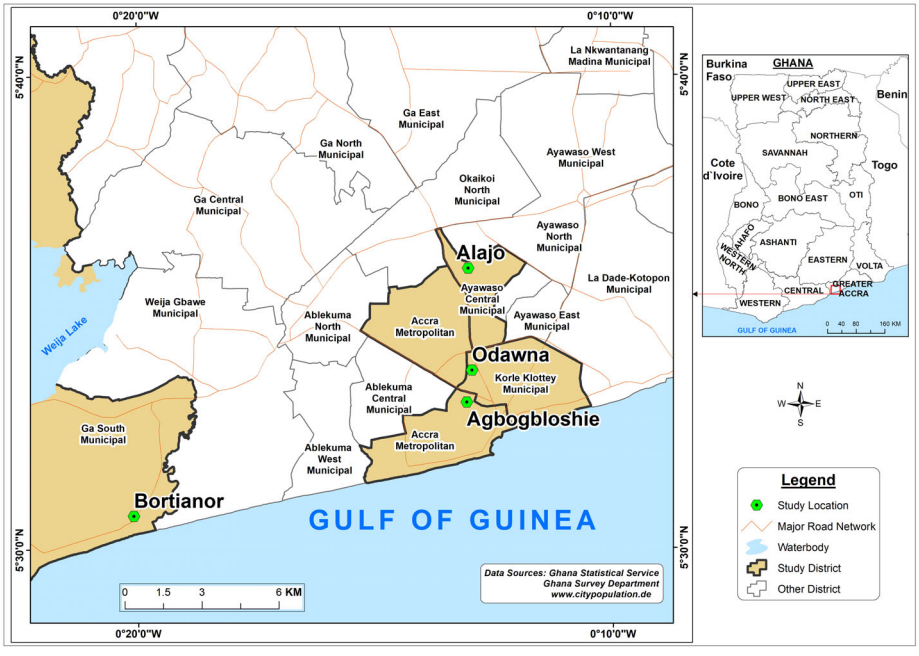

Figure 1. *Map of Accra showing the study sites.*
Source: **Authors' construct.**

members, a teacher, a chief's son, and well-connected entrepreneurs. The community Champions acted as our key contacts and resource persons, and in all cases, their knowledge and insight were invaluable to the research.

In order to gain insight into how low-income urban residents are impacted by flooding events, qualitative data were collected in 2019 through semi-structured interviews, focus group discussions, and follow-along participant observation (FAPO). Around 15 households were purposively selected per settlement to cover a range of: housing types and densities, locations, household sizes and compositions, types of home-based enterprises, and vulnerability to extreme flooding. The process was guided by our extensive knowledge of the settlements and by suggestions from the community Champions. The interviews explored how extreme flooding impacts respondents' mobility, daily activities, and their coping/adaptive strategies.

The participants interviewed varied by age (from 18–65 years) and gender (37 per cent male and 63 per cent female); two-thirds were homeowners and one-third tenants. In each community, two opinion leaders, including Chiefs and unit committee members, were also purposively selected to be interviewed about their settlement's flood histories, hotspots, interventions and future plans. Consequently, a total of 124 interviews were conducted, either in English or a local language depending on the preference of the interviewees, and they lasted between 45 minutes and two hours.

Three focus group discussions were also conducted within each community, (i.e., 24 in total). These were: 1) male groups, aged 36–65 years, 2) female groups, aged 36–65 years, and 3) mixed gender youth, aged 18–35 years (using 35 years as the upper age coincides with the definition of youth used in Ghana and some other sub-Saharan African countries, see Chigunta *et al.*, 2005). While older males and females preferred to be interviewed

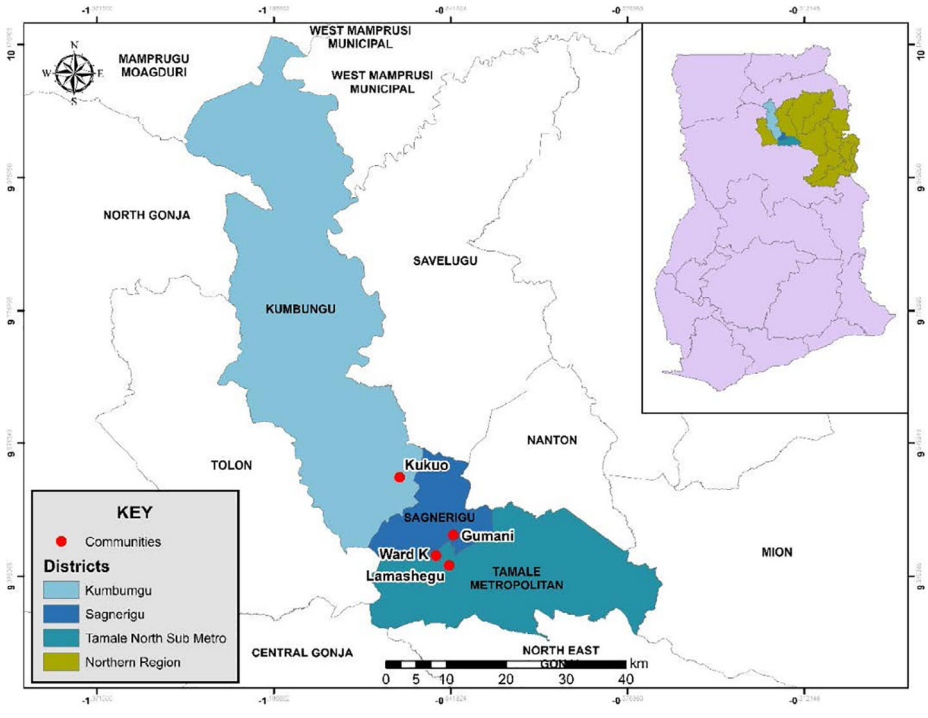

Figure 2. *Map of Tamale showing the study sites.*
Source: Authors' construct.

separately in order for women's voices to be heard, the young people indicated that no gender distinction was necessary since young women are not afraid to speak up in front of their male contemporaries, which proved to be the case. Each group consisted of between 7 and 11 participants, with discussions lasting between 90 minutes and two hours.

Field observations included participating in transect walks, engaging in informal interactions with urban residents, and photographing flood prone areas. The height of previous flood events was visible on many structures (Figures 3 and 4). As the Champions were residents of the study communities, they were able to supplement the project members' field observations with live visual recordings of flood events. The videos and photographs were visually analysed to gain a better understanding of the frequency and intensity of flood events. In addition, 'follow-along participant observation' (FAPO) (see Finlay & Bowman, 2017) was conducted, which involved the authors accompanying three low-income urban residents per settlement as they traversed the city. The participants were all flood victims whose economic activities necessitated engaging in mobility. The FAPOs were conducted during the rainy season, which enabled us to record how the participants' everyday mobility was shaped by extreme weather, household vulnerabilities, and community expectations. The FAPOs thus generated additional insight into the implications of extreme flooding and improved our understanding of the nuances of the life worlds of marginalized urban residents. Detailed ethnographic fieldnotes were kept and subsequently analysed using NVivo 11.

In the selection of participants for interviews and FAPOs, there were minimal ethical risks as recruitment took into account concerns regarding inclusivity, privacy, undue influence and voluntary participation, while also complying with ethical

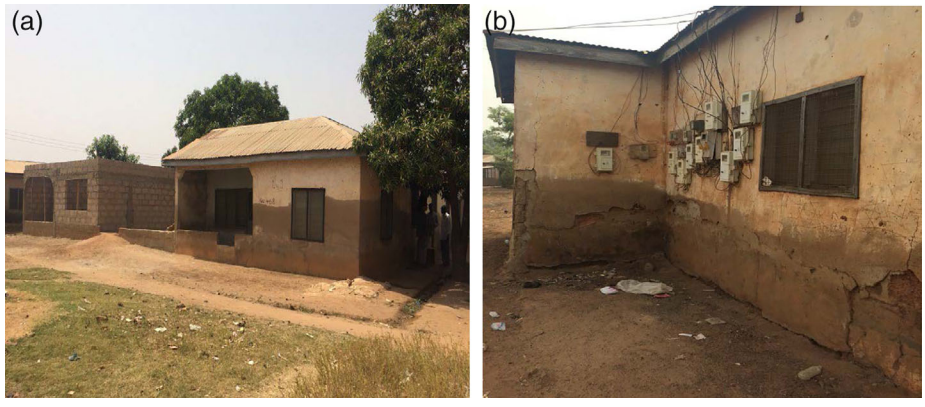

Figure 3. *High flood line clearly evident on buildings in study communities.*
Source: **Authors' fieldwork.**

requirements regarding working with human subjects. The interviews were recorded with the informants' consent and transcribed verbatim. Using a deductive (theory driven) approach, the transcribed interviews were coded and thematically analysed using NVivo 11 to draw out key themes and trends; any differences in opinions regarding the themes and coding were reconciled through discussions and consensus. The emerging findings from this exercise were further discussed, following which the coding structure was revised and the final version was applied using NVivo 11 software.

Extreme flooding and disrupted mobilities in Accra and Tamale

Flooding affects the ability of urban residents to move around the city and disrupts their daily activities in multiple ways. We divide the discussion here into three parts examining first, the impact on road and transport infrastructure, second, the daily mobility challenges residents face, before third, looking at the coping and adaptive strategies they adopt.

Disrupted road and transport infrastructure

The condition of roads and the nature of transport infrastructure greatly influence urban residents' mobility patterns and activities. Previous studies have highlighted how floods affect the road network, with consequent service interruption and mobility disruption (Cook & Butz, 2013; Moller-Jensen *et al.*, 2022). Flooded surfaces and unmotorable roads are the most common barriers to mobility among low-income urban residents (Andreasen *et al.*, 2022; Böcker *et al.*, 2013; Ryser & Halseth, 2008). Most injuries and fatalities during floods occur when attempting to cross floodwaters, either on foot or in vehicles (Salvati *et al.*, 2018). The findings from Accra and Tamale support these overall trends, however, there are clear differences in how roads and various modes of transport are impacted between the two cities due to their differing infrastructure, population sizes and densities, and length of journeys.

In Accra, low-income residents use trotros that ply fixed routes for set fares to reach destinations that are too far to walk on foot. Since few low-income urban residents can afford to live centrally, they have long work-related journeys, often setting out very early to avoid the ubiquitous traffic jams, especially during the morning and evening rush hours. As Møller-Jensen (2021: 2) claims, 'commuting in Accra involves moving

Figure 4. *During and following flooding event in the study communities.*
Source: **Authors' fieldwork.**

through severe traffic congestion while navigating a volatile and inefficient public transport system, as well as dangers and hindrances on the road'. As Andreasen *et al.* (2022) also found, during severe floods fewer trotros run and those that operate take different routes as major roads leading to the city centre become inaccessible, making it very difficult to find transport. In the words of Miliki, a woman living in Odawna, 'travelling to the market and city centre becomes a harrowing experience of fear and uncertainty'. Respondents indicated, however, the need to improvise and maneuver these new routes in order to maintain their mobility, especially in relation to essential income-generating activities.

In low-income areas of the city, most roads are unpaved and even under normal weather conditions, finding transport can be a challenge. During flooding events, these challenges increase notably. Nancy, a 40-year-old female sales agent in Agbogbloshie explained how:

> When it floods, because our roads are not good at all, the vehicles use the main road. Only a few cars like pure water trucks, charcoal trucks and taxis come here. So you are restricted. You either walk long distances to catch a trotro on the main road or you pick a dropping [hire a taxi].

This dilemma Nancy identifies, reveals how either she has to walk far to the main road to find a trotro or take a taxi to where the trotros pass by, which is expensive. This is not the only additional cost low-income residents face. Okyeame, a 47-year-old male living in Bortianor indicated that under severe weather conditions, the trotro drivers extort extra money from passengers by dividing what should be one journey into two, hence charging double:

> The trotros take advantage of us. They pretend to be going to the next popular drop off or station but not the last stop. But when they get there, before you realise they will start loading to go to the last stop. In the end, you are forced to pay double fares for what should have been one trip.

The problem of finding transport to return home from the city centre is especially an issue for inhabitants of Accra during flooding events. As there are insufficient trotros, sometimes a group of friends, colleagues, or even strangers waiting at bus stops agree to share the cost of a taxi. This has become easier since the arrival of Uber and other online taxi services in Accra, resulting in individuals being able to call a taxi to

where they are, rather than only being able to flag down one that is passing (Acheampong *et al.*, 2020). Even though such mobile technology-enabled rides are expensive to use during heavy traffic, respondents indicated it is preferable to getting wet while waiting at a bus stop with no shelter. A few respondents also described cancelling and postponing planned trips when it was raining heavily due to the lack of sheltered areas to wait for transport. Thus, several conditions and circumstances interact to postpone and alter actions and mobility behaviour during heavy rain and flooding. Mustapha, a 44-year-old male cattle farmer living in Odawna explained how trying to find transport 'gets worse during the evening after-work rush hour because you see a lot of people crowded at the bus stops.… Some drivers also do not want to drive in the dark during flooding'. His final point highlights how anyone having to travel after dark (shortly after 6 pm) faces even greater difficulties getting around the city.

In normal weather conditions, moving around Tamale is not as challenging as Accra given its smaller size and less frequent and shorter traffic jams (Fuseini *et al.*, 2017). Moreover, residents often navigate the city on their own bicycles or motorbikes, or pay to use motorized tricycles and the limited number of shared taxis that ply fixed routes. During flooding events in Tamale, roads become unpassable as overflowing gutters result in them being covered in deep water and mud, greatly impacting residents' mobility mode choices. As Fuseini, a 51-year-old farmer in Lamashegu, pointed out, 'The floods prevent motorized passage. The motor-kings [tricycles] can't come here. We can't move with our motorbikes and we can't even pack them in the house'. Similarly, in Kukuo a resident reported that, 'We find it difficult to pass through the community with our motorbikes as the road becomes very muddy. The tricycles are unable to ply this route as they can easily fall when negotiating a curve. It happened to my neighbour's wife and children' (Nuhu, 38-year-old male mason). Nuhu's final comment reveals the potential dangers that residents can face as they try to navigate the city in extreme weather conditions. Journeys around Tamale can become 'challenging, extorting and painful', as pronounced during a male focus group discussion. Whilst such challenges are greater for lower income residents, who are more likely to live in flood prone areas and have fewer transport options, the poor nature of most roads in Tamale means that all residents have to negotiate moving around the city carefully during flooding events.

Walking is another common way of moving around neighbourhoods, though most urban residents in Ghana consider the weather to be too hot and humid to walk long distances. The fear of falling into open gutters that line the roads when they are filled with floodwater, however, discourages urban residents of all age groups from walking outdoors even when close to their homes. As Alberta, a 28-year-old female food vendor in Agbogbloshie explained, 'The flood covers the whole place so if you don't watch carefully you might fall into the gutter'. Especially older adults in both cities in particular, reduce walking outdoors during flooding to avoid falling in the slippery and muddy road conditions. Less dramatic but still important to pedestrians is the risk of spoiling shoes and clothes. Yasmin, a 53-year-old female trader in Tamale indicated that 'The annoying part is if you don't traverse [roads] carefully, the motors or tricycles will splash muddy water on your dress'. Whilst motorbike use has been minimal in Accra, in contrast to Tamale, in recent years there has been a rise in the use of motorbike taxis referred to as 'okada' (Alimo *et al.*, 2022). In order to avoid walking in muddy neighbourhoods in Accra, George, a 43-year-old shoemaker, recounted during the male focus group discussion in Agbogbloshie that, 'Due to the muddy nature of the roads after the rains, people now use okada to move about here. Even that one is not safe but you don't want to dirty yourself or slip in the mud'.

As this discussion has illustrated, factors that influence whether urban residents can access motorable roads and transport services include the severity of weather conditions, changes in transport routes, and the time of day. Roads and transport services underpin urban mobility and become particularly important during extreme flooding. We now turn to examine how flooded roads and limited transport availability affect urban residents' daily activities.

Daily urban mobility challenges

This section is devoted to the mobility challenges low-income urban residents face during extreme flood events, focusing on how these impact their everyday activities. Motivations for moving around the city play an important role in influencing mobility behaviour under different weather conditions (Böcker *et al.*, 2013). The impact of flooding varies depending on whether the mobility is time-dependent or time-independent, as well as on individual socio-economic characteristics and circumstances. The discussion is structured around everyday activity patterns in relation to work, education and health, and social activities.

Income-generating activities in Ghana are generally gender specific; the most common urban livelihood activities for women are working as an independent trader, seamstress or hairdresser, often running a small business from the home or a nearby workplace (Darkwah & Tsikata, 2021; Gough, 2010). Despite the close proximity of the home and workplace for many low-income women, this does not mean that they are immobile when working. Women move around the city and beyond in order to access goods and raw materials for their businesses or visit customers (Darkwah, 2007; Esson *et al.*, 2016). Men engage in a wider range of income-generating activities, including moving into ones traditionally dominated by women due to financial necessity (Overå, 2007; Amankwaa, 2017). Male urban residents are less likely to work from home and more likely to travel daily to workplaces than women (Gough, 2010; Esson *et al.*, 2016). Consequently, the mobility impacts of extreme flooding are gendered.

Respondents travelling to/for work described how flooding caused them to be late or cancel their trip, which has financial consequences. Employees indicated how they phoned their workplace to inform about being late or their inability to travel to work due to a flood-induced mobility disruption, emphasizing that 'the boss is normally aware when the flood is widespread'. Generally, however, postponed mobility in relation to work is considered to have fewer consequences compared with cancelled mobility. This stems from perceptions of acceptable behaviour shaped by workplace culture, as captured in a quote from Rashida, a 30-year-old fashion designer, during a youth focus group discussion in Alajo:

> … if you don't go to work you can lose your job because some managers are strict. At my former workplace they used to provide buses so even when it rains non-stop you have no excuse. You are expected to run through the rain and hide somewhere to wait for the bus.

Business owners expressed frustration at not being able to sell, or at losing customers and 'deals' during flooding. This was highlighted by a nightclub operator in Accra who intimated, 'Your movements and all your quick deals are distracted'. The financial implications of not being able to work can be severe for low-income urban residents. Meshack, a 30-year-old male cobbler in Bortianor explained how he struggles when the area is flooded since people have other priorities: 'When people do not have money to buy food, no one will pass through the rain to fix their shoes, so you

will go hungry'. Another young man from Bortianor similarly explained how his wife's business is impacted by flooding because residents are unable to come and purchase from her. Consequently, she works until late in the night in order to try to sell all the food she has made, though at times they end up eating it themselves.

Tamale residents also face work related challenges during flood events. Abdullah, a 35-year-old female trader in Gumani, summarized how her families' income-generating activities are affected by flooding:

> When it floods, my husband and son can't go to work. This affects us because he [husband] won't be able to give chop money.[2] I can't also sell for days because I can't get any place to set up my table to sell on it. So we have to depend on our savings or others for help.

A wide range of work types are affected by flooding; respondents recounted how masons are unable to mix mortar, carpenters cannot work effectively, traders who sell in the market have no customers, and business owners are unable to move around the city to buy the goods they require. For residents who have to seek employment on a daily basis, the floods are also devastating. A young man in Tamale explained how during flooding events, 'When you are unemployed you can't go out and search for work'. It is not only income-generating/seeking activities, however, but also unpaid housework, which is primarily the preserve of women, that is impacted by major flooding events. When homes become flooded, the damage is extensive, requiring major cleaning up afterwards. Women in Alajo explained, 'You have to clean up your home before you can even think about [paid] work. For a whole two weeks, you'll just be undertaking cleaning and drying activities. When flooding occurs, our finances go down'.

School children can find it difficult to reach their schools or return home early during flooding events, which not only disrupts their learning but can have financial repercussions for households. It can also be dangerous for school children to attempt the journey, as a female respondent from Agbogbloshie explained, 'The schools around have established that when it rains we should not allow them [children] to come to school because of the floods. Even the older children can drown in the water'. The teachers may also face challenges reaching their schools, as a respondent in Tamale explained, 'The other day the teacher who teaches at Tolon school couldn't go to work because of the flood'. Most respondents, however, indicated that they rarely stop their children going to school under severe flooding conditions, preferring to improvise and find alternative routes that avoid the floods. As a quote from the male focus group discussion in Agbogbloshie indicates, this is not without consequences: 'When it rains, I stop working and take my children to school through a different route, which is long so it makes them late and dirty and it affects my work'. Delayed or postponed school related mobility is preferable to cancelled mobility, however, since the latter affects parents' work even more. Mothers in particular are those who have to postpone and cancel their income-generating activities to look after their children.

Turning to health-related mobility (McMichael, 2020), flooding events affect both pre-planned appointments and emergency situations, as well as generate additional health impacts and costs. Respondents indicated that when there are floods, they self-medicate and/or reschedule their hospital appointments. A 38-year-old male tailor in Agbogbloshie intimated how, 'When it floods we can't carry the sick to the hospital so we self-medicate before taking the person to the hospital later. But it's not easy because you don't easily get some medicine'. In such situations, it is possible to obtain

regular medication from nearby drug stores but not those that require a prescription. The reluctance to engage in health-related mobility is linked to the challenges faced trying to reach hospitals and having to stand in long queues before seeing a doctor, both of which impact income-generating activities (Codjoe *et al*., 2020). Women with school-aged children and the elderly are especially affected due to their caregivers' role. As Akorfa, a 28-year-old mother and food vendor in Accra commented, 'If the children are not able to go to school, we are not able to visit the clinic'. Postponed health-related trips also have consequences, since waiting times lengthen due to the increase in the number of people subsequently attending the health facility. A 59-year-old unemployed male in Accra remarked: 'We cannot visit health facilities when everywhere is flooded. We can only visit later, and usually, the facilities get crowded after the floods'.

Mobility for health professionals is also difficult during flooding events. Rashida bemoaned the situation explaining how, 'If you are a doctor and you have to go and save someone's life in an emergency, you cannot go because the flood has blocked you. A doctor drowned in a car because of floods'. Such a situation was exemplified by Cynthia, a 45-year-old teacher in Alajo, who narrated a distressing incident she witnessed:

> I remember during one of the flood events, a woman was in labour. Alajo Junction and Kotobabi were flooded so there was no way to take her to the hospital. While waiting for the flood to recede, she delivered the baby before we could take her to the hospital. We had to carry the child and her mum on a hand-push truck through the flood to the hospital.

Those travelling for time-independent mobility activities, such as visiting a neighbour, a store or the city centre, also encountered the impact of restrictions on their mobility during floods. George, a 43-year-old shoemaker in Agbogbloshie, explained how even his ability to engage in a time-dependent activity, such as going to church, is restricted:

> From the Accra Brewery area there is too much mud. Sometimes on Sundays we can't even go to church. When you polish your shoes, you can't use them to walk in the mud. So you wear boots or slippers [sandals] and change when you arrive. So the mud is an everyday big worry because you can't go where you wish to go or dress the way you want.

Respondents shared experiences and feelings of being trapped, including being unable to enter or leave their communities and becoming immobile as a result of flooding. Becoming stuck and immobile causes enforced idleness and can make urban inhabitants feel disconnected as they become confined indoors or within their immediate environment. During the female focus group discussion, a 35-year-old businesswoman retold how: 'We experienced a flood event about three months ago. People outside the bridge at the other side of Alajo could not come in and those inside Alajo could not move out. So you feel trapped'.

Although the disruptions to mobility subside after the occurrence of an extreme weather event, the impact can be ongoing. Participants in the male focus group discussion in Agbogbloshie agreed that: 'Normally your day will be lost by the time the rain stops', and, 'Until the floodwater recedes, your days are lost because you can't go anywhere or do anything'. Contributing to this conversation, Ahmed, a 58-year-old tailor remarked:

> When it floods in Agbogbloshie, we can't move around … we can't even go to each other's houses. We only have to wait for the water to dry up before we can move anywhere. There is

> no human or vehicular movement and no selling and buying activities. All the communities surrounding Agbogbloshie get flooded, you don't see people around. We are at the mercy of the floods!

In Accra, numerous respondents recounted their experiences and sentiments of being trapped in their community and cut off from the city during the 3 June 2015 flood and fire event. Most central routes became inaccessible, and many businesses were shut-down. Under such circumstances, participants in the female focus group discussion reminisced about their fear of the floodwater and their emotional agony. They recalled how, 'Everything was at a standstill', which increased the number of mortalities as vehicles transporting victims could not reach the hospitals. As the following interview quote highlights, the severe disruption on mobility patterns heightened urban residents' feelings of helplessness and their sense of being disconnected from the city:

> Most people could not return from work because the roads were blocked with flooded water. The children were stranded in the flood and we couldn't go for them from school. The women were stuck and most of them slept outside the community. Those who could get back lost most of their belongings. It was a dreadful event.

Through an analysis of residents' experiences of disrupted everyday mobilities, we have shown how extreme flooding impacts income-generating activities, education, health and social life. Importantly, these impacts are not mutually exclusive—mobility/immobility in one sphere affects mobility in the other spheres. Flood-disrupted mobility has been shown to have differential impacts on residents depending on their location in the city, the intensity of flooding, and their mobility pattern, i.e. where they are going. Whilst all urban residents' mobility is affected by flooding events, older people, a group whose mobility is already constrained (Wignall *et al.*, 2019), find it especially difficult to move around the city as they have to postpone or improvise in order to navigate mobility disruptions. Children also have to take great care and be assisted to overcome any activity restrictions. As well as generational differences, we have also demonstrated how the impacts of extreme flood events on mobility are gendered, exacerbating the mobility inequity that occurs under normal weather conditions in Ghanaian cities (Møller-Jensen, 2021). We now turn to discuss the coping and adaptive strategies adopted by residents of Accra and Tamale before, during and after flood events.

Coping/adaptive strategies

This section analyses the coping and adaptive strategies respondents employ during extreme flooding to navigate the consequences of mobility disruptions and activity restrictions on their everyday life. The respondents' experiences show how individual capacity and sensitivity to mobility disruptions shape their coping and adaptive strategies. Key variables include: income levels, trip characteristics, alternative travel modes and routes, preparedness for extreme weather events, and ability to adjust travel behaviour.

Personal attributes do not only influence an individual's sensitivity to extreme weather events but also affect their ability to mitigate and adapt to mobility disruptions. When extreme flooding results in the loss of pay or daily earnings, individuals in lower income brackets are the most impacted. For example, although they draw on their social networks to try to find a free ride when the transport network is disrupted, they have limited success since those contacted rarely have the capacity to offer transportation. Another form of adaptive capacity is the level of preparedness and improvisation

for mobility disruption caused by flooding. For example, leaving earlier than usual or hiring a taxi or motorcycle in advance to complete a time-dependent trip. For women, however, doing so usually implies sacrificing other household roles they are expected to perform, such as food preparation or taking their children to school (Williams *et al.*, 2022).

Both the transport system and trip destination emerged as external factors influencing residents' adaptive capacity. Commenting on how road conditions influenced respondents' coping strategies and improvised mobility, Maimunatu, a 45-year-old woman in Lamashegu, noted how, 'We take off our slippers [sandals] when walking in the flood or mud, and keep our children home to avoid feelings of fear of being stranded'. In anticipation of floods, during periods of heavy rain residents deliberately avoid places where flooding could occur. A male trader in Accra explained: 'We are in May. Entering June could be a problem because the June-July rains slow business. A lot of people leave the market to sell elsewhere or work extra hours to earn money to support daily living'. By deliberately avoiding travelling into the centre of Accra, such traders are pre-empting a situation where they might either be unable to get to work or return home. Another pre-emptive action is picking children early from school during flood events. George, a 38-year-old male tailor in Agbogbloshie, explained how, 'We usually go to the school premises to rescue children anytime it floods. We leave our jobs to do that … if you don't strategize, they will be playing in the flood'. These individuals exhibit awareness and preparedness for mobility disruptions by making sure they plan their movements to minimize postponed mobility and improvise to cope with their mobility challenges. As previous studies have shown, travel behaviour choices are influenced by contextual factors and individual attributes, including risk perception of mobility disruptions (Böcker *et al.*, 2013; Cook & Butz, 2013; Williams *et al.*, 2022).

At times, residents assist others in their mobility during flood events, for example, when the gutters become flooded. Nancy, a 40-year-old sales agent in Agbogbloshie, Accra recounted how:

> … when you get there, there are some boys around who will help you to cross it [gutter]. … At times too, there are no cars so whether it is an elderly person or a child, they just carry the person on their back and even take them to the hospital.

By providing such assisted mobility, young men help children, the elderly and the sick to navigate the city. Similarly, in a Zambian context, Gough *et al.* (2016) noted how young men would come to the assistance of residents trying to access their homes in a low-income settlement in Lusaka by offering the use of gum boots. In this instance, however, the young men were highly entrepreneurial, charging a small fee for the use of the boots to cross flooded roads.

Urban residents also assist others who become stuck due to flooding and cannot access food or other basic necessities, which is especially problematic for those who purchase food daily. A respondent during the focus group discussion in Bortianor recounted how, 'We stay in our rooms even when we are hungry because you cannot go out to buy anything'. To counter such situations, residents of Alajo described how during the last major flooding event they bought bread, which they wrapped in a polythene bag, tied to a rope, and threw to neighbours who were trapped. This shows how innovative urban residents are in providing assistance when others become trapped by floodwater.

Conclusions and policy implications

This paper has provided new insight into the confluence between extreme weather, disrupted mobility and everyday navigation of the city. The findings show how extreme flooding influences the everyday mobility and daily activities of urban residents in Ghana. Flooded roads and gutters, and muddy road conditions, impact the transport system and disrupt not only residents' mobility but also restrict their mobility modes. This situation produces new forms of mobilities, which have three relational elements: postponed, improvised and assisted. Whilst all urban residents experience postponed mobility, young people especially, engage in improvised mobility, whilst children and the elderly are most likely to need assisted mobility. Although the forms of disrupted mobilities and navigating strategies practised in Accra and Tamale are similar, they are more intense in the former due to more frequent flood events, combined with the greater everyday mobility challenges associated with living in a major city. At its most extreme, the disruption caused by flooding results in urban residents becoming trapped and experiencing enforced idleness, resulting in them feeling disconnected and marginalized from the rest of the city.

By underscoring that micro-level analyses are needed to reveal the nuances of how urban residents' mobility is influenced by extreme flooding, this paper complements studies which show how extreme weather events trigger and impact internal and international migration (see Berlemann & Steinhardt, 2017; Roeckert & Kraehnert, 2022; Wiederkehr *et al.*, 2018). We highlight that increased attention needs to be paid to how contextual factors, including socio-demographic characteristics and income-generating activities, influence intra-urban mobility during extreme weather events. Understanding who can move and how this movement is embodied (Cresswell, 2010), is thus key. Consequently, our findings extend knowledge regarding the complexity of urban residents' responses to flooding, especially in resource poor settings where mobility and livelihood activities are intricately intertwined (Rigg, 2007). Our paper thus adds more substance to the claim that '… mobilities need to be examined in their fluid interdependence and not in their separate spheres' (Sheller & Urry, 2006: 212).

The increasing occurrence of extreme flood events due to climate change and variability require communities within and beyond sub-Saharan Africa to consider how to prepare for and mediate the impacts (Gough *et al.*, 2019; Wilby *et al.*, 2021). As urbanization continues under global environmental change, understanding flows and patterns of everyday mobility and activity in contemporary cities will become even more imperative. Several key areas beyond the scope of this paper have emerged for further study. First, whether the prevalent everyday mobility disruptions experienced by urban residents during and after flooding events can be attributed to climate change. Second, how mobility disruptions caused by other types of extreme weather events, such as storms or extreme heat, affect urban residents. And third, how extreme weather events affect peri-urban and rural residents, and the functional integration between peripheral and central areas.

Building transport systems that can cope with extreme flooding and minimize disruption to mobility and economic activities remains a major challenge facing urban planners and developers (Akyelken, 2020; Gough *et al.*, 2019; Schraven *et al.*, 2020). Knowledge of how urban residents react under specific weather conditions, both through mobility and immobility, has the potential to inform a range of policy interventions, not only in Ghana but across the global South. In the short to medium term, this includes ministries of transport, roads and highways, and related institutions

incorporating extreme weather events into urban transport planning, developing climate resilient infrastructure, ensuring efficient scheduling of public transport services, planning transport hubs and alternative routes, and widening the opening hours of key services (Böcker *et al.*, 2013; Williams *et al.*, 2022). Awareness of urban residents' (im)mobility and (in)activity, as well as their coping strategies during extreme weather events, helps predict how emergency services and relief support can be best deployed. Such knowledge potentially has significant implications for designing inclusive policies that promote sustainable mobility practices and support residents' efforts to forge their everyday lives as they attempt to navigate the city in all weather conditions.

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Endnotes

1 Extreme heat was another criterion used in settlement selection but this part of the research is not reported upon here (see Gough *et al.*, 2019). All eight settlements studied experienced severe flooding and extreme heat.

2 *Chop money*, also referred to as housekeeping money, is money given to wives by their husbands for the provision of food, payment of bills and daily upkeep.

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