‘It means we are not safe’: understanding and learning from household experiences of water scarcity, flood and fire in marginalized settlements in the Cape Flats, South Africa

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Abstract

As climate change-related extreme weather events such as flooding and droughts increase in frequency and severity in most cities worldwide, there is a need to deepen understanding of disaster risks and adaptive capacities. A significant percentage of the urban population in most low- and middle-income countries live in informal settlements. Due to poor quality housing, dense settlement patterns and lack of risk reducing infrastructure e.g., storm and surface drainage systems, informal settlements have been identified as being least prepared and at higher risk for climate change issues and therefore serve as important sites for understanding these risks and capacities. Marginalized communities in settlements in the Cape Flats region of South Africa face a range of environmental hazards and risks including recurrent large-scale fires, localised flooding and inconsistent access to water supply infrastructure and more recently (2016-2018), water supply shortages across the city. This paper presents findings from a household survey with 600 participants from three economically marginalised township settlements in this region. The aim of the survey was to understand the lived experiences, coping mechanisms and resilience attributes of the residents faced with localised flooding, fires and water shortages – locally salient environmental risks and hazards. The paper explores how different forms of capital come into play in the shaping of these experiences and responses and uses these to consider power structures and the creation of particular types of habitus amongst settlement residents. Insights from this study further enhance knowledge of community resilience that could potentially inform policy development and institutional disaster risk reduction strategies for climate change resilience of cities in low- and middle-income countries.

Key words: water scarcity; floods; fire; climate change; resilience; vulnerability; informal settlements.

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1. Introduction

Two interconnected, mutually exacerbating global trends are putting an ever-increasing number of people at risk of environmental hazards or disasters: increasing urbanization and the climate crisis. As average global temperatures rise, extreme weather events are experienced more frequently, with more frequent droughts (Cook, Mankin and Anchukaitis, 2018), fire weather (Jones et al., 2022), flooding events (Pour et al., 2020) and storms (Allen, 2018). Vulnerability to these risks is not evenly distributed; instead, it is affected by factors relating to both the natural and built environment, such as location of a settlement relative to coastlines and floodplains, depth of local water tables, proximity to wildfire fuel, and so on; and to socially constructed conditions, such as relative wealth, precarity, health and education (Abunyewah et al.,2018).

While policies and strategies to combat, mitigate and adapt to climate change are developed at national and supranational levels, increasing urbanization also means that our capacity to cope with climate change-related disasters is tightly tied to our cities' capacities to cope. This makes the development of city- and city-region level strategies increasingly important. Initiatives including the UN's Sustainable Cities Thematic Network, the Rockefeller Foundation's 100 Resilient Cities and follow-up Resilient Cities Network and a variety of academic-led networks on similar topics seek to help cities around the world to develop climate action plans, sustainable development strategies, and to embed equitable sustainability in such practices and processes.

Increasing urbanization is largely caused by a combination of overall population growth and population movements from rural to urban areas, as people move in search of employment and higher living standards. Climate change is also increasingly being linked crop failure, disease outbreaks and desertification all of which influence rural to urban migration.It is estimated that 66% of the world's population will be living in urban areas by 2050 (Williams et al., 2019; UN Department of Economic and Social Affairs, 2015). Urbanization is increasing most rapidly in low- and middle-income countries, putting additional pressures on limited formal settled spaces – that is, those spaces that are formally recognized by local authorities, where adequate quality housing is available, and where urban infrastructure such as electricity, water and sewerage, transport systems and waste management systems are in place/accessible. Ever-increasing numbers of people are forced to reside in informal settled spaces, especially across Asia, South America and Africa: for example, 80% of the population of Dar es Salaam, Tanzania's largest city, live in informal settlements (Kiunsi, 2013; UN-Habitat, 2015; Satterthwaite et al., 2020).

Informal settlements are likely to be particularly vulnerable to climate-change related environmental hazards such as drought, fire and flood events (da Silva, Kernaghan and Luque, 2012; Jabeen, Johnson and Allen, 2010; Satterthwaite et al., 2020). They are usually situated on land that has not already been occupied due to unfavourable development characteristics, such as floodplains, landfill sites and coastal edges and in some cases far from employment opportunities. Population densities are usually very high, and residents are faced with a range of chronic socioeconomic challenges such as poverty, high unemployment rates and failure or absence of infrastructure including drainage, water and sewerage, electricity and transport (Douglas et al., 2008; Satterthwaite et al., 2020). Poor quality materials used to provide water-based infrastructure and services (e.g., taps, pipes, toilet structures etc) to these settlements often results in the failure or non-accessibility of

these water services due to vandalism and theft of better-quality fittings for personal use or resale (Drivdal, 2016). Without formal development and investment, informal settlements also usually consist of buildings that have been constructed by residents using whatever materials are to hand; some which are easily combustible such as timber frames and plastic sheeting, and thus do not conform to minimum building standards. These vulnerabilities are often compounded by weak levels of governance (UN-Habitat, 2015), with urban strategies and policies for coping and adapting to climate change potentially failing to connect to the needs and capacities of informal settlements.

If city- and city-region level strategies are to have lasting utility and positive impact, it is crucial that they recognize and speak directly to the significant fractions of the population who reside in informal and marginalized settlements. Although there is a growing body of research focusing on climate resilience in informal settlements (Jabeen, Johnson and Allen, 2010; Lakhani and Andharia, 2020; Revi et al., 2014; Satterthwaite et al., 2022; Usamah et al., 2014), there remains a need to deepen understanding of disaster risks and adaptive capacities at individual, household and community levels in informal settlements. This paper presents findings from an interview-based survey of 600 households in three economically marginalised township settlements in the Cape Flats. The aim of the survey was to understand the lived experiences, adaptive capacities and resilience attributes of these households as they face climate change related environmental hazards of water scarcity, fire and flood events.

2. Conceptual framework: resilience capacities, capitals and habitus

Much of the recent academic and policy discussion around responses to climate change adopts a discourse of “resilience” (see e.g. Davoudi et al., 2012; Department for International Development, 2011; Gilbert, 2016; Manyena, 2006; Manyena et al., 2011; Paton and Johnston, 2017; Satterthwaite and Bartlett, 2017; Satterthwaite, 2020; Theron, 2016; Usamah et al., 2014). Resilience, in disaster risk management and development contexts, is often defined in relation to a system’s capacity to recover from and adapt to shocks – that is, to persist through and maintain functionality after extreme disturbances from historically and locally normal conditions. The notion of shock can be further broken down into a three-phase “disaster cycle” (Gaisie, Han and Kim, 2022; Houston et al., 2019), comprising before, during, and after. The United Nations International Strategy for Disaster Reduction’s (UNISDR) definition of resilience, which is widely referred to in academic work across a range of disciplines, including environmental science, geography and urban studies, captures resilience in relation to each of these phases: ‘*the ability of a system, community or society exposed to hazards to resist, absorb, accommodate and recover from the effects of a hazard in a timely and efficient manner*’ (UNISDR, 2011). That is, conceptions of resilience need at a minimum to relate to preparedness for hazards (including prevention and mitigation measures), abilities to absorb and cope with immediate impacts and capacities to recover, repair, rebuild and adapt. It is worth noting that, although the UNISDR definition successfully captures the three stages of disaster, it tends to focus on large scale systems (“community” or “society”); however, it is also important to consider the conditions needed for the resilience of households and individuals, especially in informal settled spaces where infrastructure to support both daily living and disaster recovery may not be in place.

There have been several recent efforts to explore conditions for resilience in terms of

"resilience capitals" (Bruneau et al., 2003; Cutter, Ash and Emrich, 2014; Dakhal, 2018; Gaisie, Han and Kim, 2022; Lakhani and Andharia, 2020; Mayunga, 2007; Yoon, Kang and Brody, 2016). These are intended to emphasise capacity and agency over a deficit model of vulnerability. Although these authors generally draw on extended sets of capitals including economic, social, human, environmental, physical and infrastructural, and represent them as sources of resilience capacity, there is no agreement on which capitals to use as a framework for analysis, nor indeed what might comprise each capital. There is also no clear evidence that access to each of the capitals enrolled in this conceptual work always correlates with capacities to deal with all the phases of the disaster cycle, with recent research suggesting that, in some disaster contexts, some capitals may in fact correlate negatively with increased resilience in particular phases (Gaisie et al., 2022).

We suggest that the notion of resilience capitals may be more effectively put to work if we return to their origin in Bourdieu's (1979; 1985; 2018) introduction of symbolic capital. Bourdieu suggested that social structures and power relationships, as exemplified by social class, could not be explained with reference to the forms of wealth identified in Marxian economics (capital, human labour and land) alone. Bourdieu introduced social and cultural capitals to explain class-based differences in educational outcomes that he argued could not be explained by access to economic capital. Such capitals can be embodied (as knowledges and practices contained in the minds and bodies of individuals), objectified (as, e.g., works of art) and institutionalised (e.g., in the form of educational qualifications) and thus can be both accumulated and, to a greater or lesser extent, exchanged with economic capital. The purpose of these additional forms of capital is to help explicate inequality, competition, stratification, power and social reproduction, all of which are important in understanding disaster risk and response.

Bourdieu's capitals should not, however, be understood and operationalised on their own. Capacity and agency, which may indeed be enabled through the acquisition of specific forms of capital, are also constrained by systemic and contextual characteristics (especially those that set norms relating to value and values) and the prior history and pathway of an individual's interaction with the system she or he acts within. The choices and actions that are open to any individual person are limited by both their access to different forms of capital and their *habitus* – that is, the set of physical, mental, cultural and social habits, attitudes, assumptions and presumptions that they hold at any given time. A lack of access to certain capitals can reduce a person's options and choices; their habitus may result in even narrower perceived horizons for action. It is thus particularly important to understand the multiple ways in which risk, hazard and disaster are experienced, and the multiple ways in which people – as individuals and as households – respond to and learn from these experiences. That is, we need to understand how a disaster-response habitus is shaped by experience of exposure to disaster and risk of disaster. As Gaisie et al. (2022) demonstrated, access to or possession of particular capitals and resources may sometimes correlate negatively with resilience capacities in certain phases of the disaster cycle. An expanded set of physical and symbolic capitals, together with the idea of habitus, may thus be particularly useful in identifying ways in which "resilience actions" might actually serve to embed and reproduce structures of inequality. City-level resilience strategies may then be designed to explicitly recognise these social, material and technical structures.

3. Water scarcity, flood and fire in marginalized settlements in the Cape Flats

The empirical research reported below explores the experiences of residents in three marginalized settlements in Cape Town's Cape Flats area in South Africa. It constituted the first cycle of research in a three year project, PROJECT NAME REMOVED FOR ANONYMOUS REVIEW, informing the design of subsequent cycles. Large-scale urbanization and population increases (including immigration from neighbouring countries) in Cape Town have led to an influx of people settling in poorly located, inaccessible peripheral land. The people occupying these spaces face a range of well-documented social and economic challenges (Douglas *et al.*, 2008; Drivdal, 2016; Enqvist and Ziervogel, 2019; Sacks, 2014; Scheba and Turok, 2020), which are being made worse as the climate changes. As a legacy of apartheid town planning and a history of forced removals, South Africa's township and informal settlement residents endure dislocation from the mainstream economy and society and face highly constrained development and employment opportunities (Ziervogel *et al.*, 2016; Roberts and O'Donoghue, 2013). This inequality has been amplified by inadequate, over burdened and under capacitated post-apartheid governance (Enqvist and Ziervogel, 2019) and consequent concentration of environmental hazards and risks amongst the poor. Water scarcity, flood and fire events occur regularly and with increasing frequency (Madzwamuse, 2011).

The three research sites described here were chosen to explore experiences of each of these three environmental hazards. While all the three hazards exist across these sites, the research in each site has focused on one hazard alone.

3.1 Water scarcity in Delft South

The city of Cape Town has faced increasing issues of water scarcity over recent years resulting from reduced and changed rainfall patterns (Enqvist and Ziervogel, 2019). From 2015 to 2018 the city experienced the worst drought in its recorded history, resulting in acute urban supply water shortages and city-imposed restrictions and controls (Millington and Scheba, 2021). Strategies to reduce water consumption included increasing water tariffs, imposing water restrictions and the installation of water management devices at individual household level. In 2018, when the South African government declared the Western Cape province to be a drought disaster zone, these devices were used by the City of Cape Town (CoCT) to limit daily water usage to 350 litres per day per household. This exacerbated water challenges for households with many people, as is very common in township settlements. In addition, lack of income and space prevented such households from purchasing and storing extra water and other liquids.

Delft South is a township settlement of approximately 50,000 people consisting of formal government-built dwellings. Delft is a culturally diverse community with various South African ethnicities and immigrant populations with diverse languages including Xhosa, Afrikaans and English. The area has much in common with informal settlements. It faces social challenges such as high levels of crime and violence. Although some households are middle-class, the majority are low-income or unemployed, with unemployment rates just above 40% (Scheba and Turok, 2020).

Delft South was established in 1989 and infrastructure is well-developed compared to other low-income areas in the Cape Flats, with more than 90% of the population having access to basic services such as electricity, water and municipal rubbish collection (Scheba and Turok, 2020). Combined with relatively robust housing and good road construction, this means that Delft South is somewhat less vulnerable to fire and flood events than more informal communities. It is thus a good site within which to study the impacts of water scarcity alone, uncomplicated by other perhaps more immediately destructive hazards.

3.2 Flooding in Sweet Home Farm

As well as water scarcity, marginalised settlements in the Cape Flats are also at risk from recurrent, often seasonal, flooding. The Cape Flats overlay a shallow unconfined aquifer, where mean groundwater levels during the rainy winter season are often at the surface. Previous studies have highlighted the complexities around finding solutions to flooding in informal settlements (Drivdal, 2016; Fox, Ziervogel and Scheba, 2021; Jordhus-Lier, 2019; Ziervogel et al., 2016). Our research explores household experiences of and responses to flooding in one of the worst-affected settlements, Sweet Home Farm.

Sweet Home Farm informal settlement was established in 1992 and is located in Philippi East on the outskirts of Cape Town. The area was originally agricultural land, then used as a dumping site for building rubble before being occupied by informal settlements residents (Pharoah, 2014). The settlement is located on land that has mixed ownership; some parts belong to the government whilst others are privately owned or are the property of Transnet (a national railway company) (Sacks, 2014). The 2011 census estimated the population of Sweet Home farm to be approx. 17,000 (likely to have increased now) comprising of Xhosa (79.8%) and Afrikaans (17.3%) language speakers. Work opportunities in the settlement or close-by are extremely limited with an unemployment rate of 38% (Sacks, 2014).

Residents of this community endure regular seasonal drainage challenges and localized flooding incidences. Flooding is induced sporadically by heavy rainfall during the winter season and extreme climatic events at other times of the year. The settlement is located near the coastline in a low-lying floodplain with a shallow water table. This means that flooding is driven by a rising water table in the winter months and lack of drainage channels to direct the water away from the settlement. While some stormwater channels and drains have been installed by CoCT, their effectiveness is undermined by poor connectivity to the piped stormwater network system outside the settlement (University of Cape Town, 2019). Waste collection services are limited and commonly delayed, which leads to accumulation of litter and piling up of household waste (Drivdal, 2016). This waste mixes with run-off, household greywater and unmaintained sewers, creating stagnant pools between dwellings.

3.3 Recurrent shack fires in Overcome Heights

Informal settlements around Cape Town are also at high risk of destructive, runaway fires (Pharoah, 2014; Olivier and Eksteen, 2017; Walls, Zweig and Pharoah, 2017; Kahanji, Walls and Cicione, 2019; Flores Quiroz, Walls and Cicione, 2021a; Flores Quiroz, Walls and Cicione, 2021b). Although fires have long been a problem in neighbourhoods with inadequate access to formal electrical connections, the increasing frequency of dry conditions and high winds combine to make fire weather more likely and thus fires become both more frequent and potentially more destructive (Williams et al.,2019). Below, we

explore the experiences of and responses to fire of residents in the informal settlement of Overcome Heights.

Overcome Heights is a predominately informal settlement, with some parts deeply informal (houses and infrastructure), but other informal dwellings having access to some formal infrastructure (such as roads and street lighting). Recognised as an informal settlement in 2005, it is built on a sand dune behind the more formal and affluent Capricorn neighbourhood. The 2011 census estimated the local population of Overcome Heights at 18,498 including migrants from other African countries. Overcome Heights is an impoverished area with a high rate of unemployment.

Overcome Heights is one of many informal settlements on the Cape Flats affected by recurrent fire outbreaks. For example, in October 2018, more than 800 people were left homeless after a fire ravaged over 309 homes in the settlement (Chiguvare, 2018). Limited access to lighting and heating (especially in winter) forces residents to use candles and paraffin stoves that increase the likelihood of informal settlement fires (Strydom and Savage, 2016; Walls, Olivier and Eksteen, 2017). In addition, the high density and haphazard pattern of homes restricts access to emergency services, preventing them from extinguishing household fires on time (Cicione *et al.*, 2020).

4. Methods

4.1 Research tool development

The aims of this research were to explore the experiences and responses to environmental hazards and disasters of residents in the three sites described above. In particular, we wanted to learn about understandings and actions at household level across all three phases of the disaster cycle. To generate such knowledge, we worked with local residents and stakeholders to create a set of questions that could be asked of residents via a survey or interview. Community engagement workshops were conducted in each of the three research sites. The workshops introduced the research project, the team, and the research aims and objectives to the community and generated collective feedback from participants about these. Based on the feedback and input from the workshop participants, the project team developed a household survey to use as the basis for structured interviews.

4.2 Household survey interviews

The surveys were used to conduct structured interviews with 600 consenting adults (200 per site). The survey questions included both closed and open questions. Early questions generated demographic and macro-level quantitative data while later, qualitative questions enquired about respondents' disaster and resilience experiences.

The survey was conducted between April and July 2020. South Africa declared a State of Disaster on the 26th of March 2020 in response to the COVID-19 pandemic. For the safety of both the field research team and respondents, the interviews were conducted by mobile telephone using communication technologies including WhatsApp, which is commonly used in South Africa. The questionnaire was implemented on the CommCare platform (a data collection and online server tool, see www.dimagi.com).

Initial interviews were conducted with participants in the workshops; additional

respondents were recruited using a snowball sampling approach. The team deliberately sought respondents from formal and informal dwellings, men and women, Xhosa and Afrikaans speaking residents, and foreign nationals. The survey-interviews were conducted by local field research teams comprised of one supervisor, four researchers and two community liaison persons resident in each research site. The field teams were diverse in racial profile and gender and members could speak isiXhosa, Afrikaans, English, Shona, isiZulu. All field researchers had good local knowledge of the research sites.

4.3 Data Analysis

Survey responses from closed questions were analysed using basic descriptive statistics. Responses to open ended questions were analysed thematically (Braun and Clarke, 2006). An initial set of themes and categories from the data was developed and refined to identify patterns within and across the research sites.

5. Results

This section presents key findings from the three research sites. First, we present data generated in response to the closed questions to provide a picture of the respondents and their households. Next, data generated from a combination of closed and open questions about the experiences and responses of respondents during all phases of the disaster cycle are presented, including; early phase ("before") data on the perceived causes as well as preparation and mitigation measures; the middle phase ("during") on the experiences of direct impacts and actions taken to respond as the disaster unfolds; the final phase ("after") on experiences and actions after the immediate threat has dissipated, and on lessons learned that will be carried forward for future events, thus closing the loop of the disaster cycle.

5.1 Household characteristics

Household characteristics are summarised in Table 1. Across all three sites, the majority of respondents were female. Respondents in Sweet Home Farm and Overcome Heights had a slightly younger age profile, with approximately 50% in both sites identifying themselves as being in the 30-39 age bracket. Delft South had a flatter and somewhat older age profile, with the most frequently selected age group being 50-59. Around one quarter to one third of respondents had no children (defined as under age 18) in their household. A little under half of respondents in Delft and Sweet Home Farm indicated having 1-2 children in the household; in Overcome heights, this rose to 58%. Across the three sites, the majority of households did not have people over 65, with Delft having the most and Overcome Heights the least. Average life expectancy in South Africa is 64 years (World Bank, 2022). The table also includes the average number of people eating from the same pot the previous night, as a proxy for the total number of people dependent on the household.

Table 1: Household characteristics

	Delft	**Sweet Home Farm**	**Overcome Heights**
Gender			
Female	74%	61%	60%
Male	26%	39%	40%

Age			
<20	1%	1%	1%
20-29	22%	11%	24%
30-39	21%	52%	49%
40-49	20%	26%	21%
50-59	29%	5%	4%
60-69	6%	2%	1%
≥70	1%	3%	0%
Average number of years in current house	14	12	7.5
Number of people in household aged <18			
0	25%	33%	28%
1	23%	19%	31%
2	22%	24%	26%
3	15%	13%	11%
4	10%	7%	3%
≥5	5%	4%	1%
Number of people in household aged >65			
0	83%	94%	98%
1	14%	6%	2%
2	3%	0%	0%
Average number of people eating from the same pot the previous night	5	4	4

5.2 Buildings and infrastructure

Additional closed questions provided an indication of the degree of informality of the respondents' living conditions. These are summarised in Table 2.

Table 2: Buildings and infrastructure access

	Delft	**Sweet Home Farm**	**Overcome Heights**
Building materials			
Brick	98%	1%	1%
Timber	0%	6%	3%
Iron sheets	0%	50%	60%
Timber and iron sheets	0%	40%	36%
Other	2%	3%	0%
Access to electricity			
Metered connection	98%	74%	78%
From another house	2%	26%	22%

Access to robustly constructed housing and basic service infrastructure is higher in the formal settlement of Delft South than in the informal settlements of Sweet Home Farm and Overcome Heights. However, all respondents had access to electricity, with approximately three quarters or more having metered, formal connections in all three sites. Delft South residents also have on property access to piped water while the residents from the other sites rely on communal taps. Similarly, residents in Delft South have inhouse access to toilets while informal settlement residents rely on communal toilets (most of which are dysfunctional) or chemical portaloos provided by the local authority.

5.3 Lived experiences of water scarcity in Delft South

Water scarcity is now a regular experience across the Western Cape region. After the 2018 water crisis, findings from this study show that Delft South residents still experience water scarcity as the CoCT continues to limit their supply to a maximum amount and stops the supply when that fixed amount is reached each day. This is a disaster that continues to be experienced to date.

Before a period of water scarcity: causes and preparedness

Most respondents in Delft South identified broken and burst water pipes and water leakages from infrastructure that are not fixed quickly enough by the local authority as factors that exacerbate water scarcity beyond the regional shortage. Other factors were linked to irresponsible use and wastage by residents, e.g., car washes, use of hosepipes and illegal water connections by back yard dwellers (people who live in informal structures within formal developed areas/properties).

When asked about preparedness measures, residents referred to a range of important factors that both helped and hindered their capacity to prepare for water scarcity. Positive measures included: keeping water storage containers e.g., buckets and tanks; drilling boreholes; and buying bottled water.

An important negative factor related to communication and advance warning. Most respondents indicated that they did not receive official early warning information from the local government about scheduled water cuts and restrictions that could have helped them to prepare for water scarcity. Instead, it was through self-experience and occasionally hearing from neighbours or members of their community that they were made aware of water cuts. Given the widespread nature of the water crisis in Cape Town in 2018, most respondents (55.5%) in Delft were aware of some official information about the pending crisis through platforms including television, social media, radio, online and pamphlets issued by the local authority. However, some respondents felt the information was not adequately communicated:

> *We were not prepared, there was no information on when it would go, could not wash or keep hygiene. we couldn't even cook on some days.* [AM007]

In addition, 62.5% of respondents in Delft could not identify or list any set formal responses that could be used to deal with the water shortages.

During a period of water scarcity: impacts and coping mechanisms

Respondents described how water scarcity impacted on many aspects of daily life. Shortages and restrictions imposed by CoCT created barriers to engaging in many activities and practices that normally defined people's lives. For example, residents described barriers

to income generation:

> *I had just arrived from Joburg and facing the water challenge was a terrible experience. Two building projects that I had come to do could not proceed because of the drought. I lost income.* (AM028).

Health and sanitation were also frequently affected:

> *I need to take medicine with water, I have little kids and regular washing is a must, in a place where 11 people using one toilet one needs water every time*. (CC154)

Residents also described disturbances to religious and cultural practices:

> *Ramadan is here and when we fast, we drink water a lot. Without it we won't be able to practice our religion well.* (AM044).

Respondents described a range of measures and actions that they took during the critical 'Day zero' period of water scarcity. These included reusing (grey) water to flush toilets and water gardens and buying bottled water. However, some measures were of a more dubious moral and legal status. Those with cars could sometimes source water outside of Delft South, in informal settlements without metered provision to individual houses:

> *Open taps in the informal settlement offer free water, that is where most people who have cars drive to. I do the same.* (AM008).

People also described collecting water from broken pipes or fire hydrants:

> *We get it from a fire hydrant, I know it's not a legal method but this is how people get it. There is also a water pipe in the field, apparently it was exposed when a front end loader was clearing rubbish, now people get water from there, it not been covered or repaired.* (AM028).

One respondent described offering bribes:

> *We were affected badly, being Muslim we need water daily they cut water and I reacted by raising this issue with council officials, had to pay R500 to someone to fix my meter, now it's free flow.* (AM044).

After a water scarcity period: recovery and lessons learned

Respondents indicated that the 2018 water crisis taught them lessons for improved preparation and coping mechanisms. Water storage and use of additional buckets, containers and tanks was cited by most respondents (82.5%) as the common strategy they would adopt should a similar situation repeat in future.

5.4 Lived experiences of flooding in Sweet Home Farm

Sweet Home Farm is prone to flooding because of its geohydrological setting, as it overlies an unconfined sand aquifer with a shallow water table. Flooding is thus both an event, when a person's house is inundated, and a constant presence in the form of standing water in the area – specifically during the wet winter season. Unlike water scarcity, flooding events can destroy belongings and even homes. A flooding event takes place on the timescale of hours

to days, but its aftermath can continue longer.

Before a flood event: causes and preparedness

Respondents attributed flood events in Sweet Home Farm to both natural and human induced factors. Flood waters come from underneath and from increased surface runoff from heavy rains. However, most respondents identified lack of proper drainage infrastructure, blocked drains and toilets as the main causes of flooding in their homes. The situation is worsened by disposal of greywater (from washing, cleaning, cooking etc.) and the use of makeshift drains.

Respondents identified several preparation and mitigation measures and actions that they could take, plus factors that helped or hindered them to do so. The most important measure was seen to be the renovation and reinforcement of houses, particularly roofs and doors. However, many people cited lack of money to buy flood defence materials such as cement and better building materials. Respondents also noted the importance of reinforcing water diversion features and barriers such as trenches and sandbags. Money was seen as the main barrier to building proper drains. All the preparation and advance mitigation activities described above were undertaken by residents of the settlement.

During a flood event: impacts and coping mechanisms

Most (81.5%) respondents in Sweet Home Farm had experienced flooding in their own homes. In responses to open questions, they described extensive damage, including soaked property and damaged furniture. Furthermore, flooding was also noted to bring increased flow of dirty water containing raw sewage and waste:

> *People dump rubbish everywhere and when flooding comes, all the dirt is washed up people's doorsteps. This poses many health problems. Children play with contaminated water and adults walk in this dirt water. This causes skin diseases and diarrhoea.* AM018.

Respondents described a somewhat limited range of damage limitation measures that could be taken during a flood, such as scooping water out of houses, digging furrows or trenches and setting up barriers (e.g. sandbags). In case of an evacuation, many respondents (51%) identified essential documents such as identity cards, passports and bank cards and clothes as priority items to take with them. All these measures were taken by the respondents, their families and friends; respondents made it clear that government and civil society response was completely absent, with 81% indicating that emergency services do not attend to flooding events in their area. They described how they were left to deal with the immediate impacts of flood events themselves.

After a flood event: recovery and lessons learned

Respondents explained how their houses remain damp and cold after being inundated. The damp conditions both inside and outside their homes were linked to diseases such as constant colds and flu, fever and skin rashes especially among children as they at times play with contaminated water:

> *Everyone got some fever each and every season no winter no summer and rash is affecting the children and everyone is coughing.* (XM048).

Some of the nuisances associated with the floods are the water pools that allow for mosquito

breeding, foul smells and unhygienic sites in the settlement.

A series of measures and actions that could be taken after the flood waters had left their homes were identified. These included salvaging belongings by drying and cleaning them, buying food and cleaning houses to remove mud and water. 70% of the respondents who had been flood victims said they had to rebuild their houses afterwards; respondents also described buying building materials, resurfacing and repairing their homes.

Although respondents described being left to cope with the immediate impact of a flood event themselves, some mentioned receiving external help afterwards, for example, ward committees visiting flood victims to assess the extent of damage, providing necessities such as food and blankets and even helping build trenches. However, 42.7% of respondents indicated that they did not have anyone to rely on for support.

Given the frequency of flooding events, it is not surprising that residents have already learned lessons from their experiences. As a result, 95.4% of the respondents indicated that before the predicted onset of the rainy season, they renovate and reinforce their houses; repair and add water diversion features such as trenches; and stock up temporary flood barriers including sandbags to minimize flooding impact.

In addition, 89.1% of respondents felt that the councillor or ward committee had done nothing to address flooding issues in their settlement. Street committee meetings were noted as being one of the platforms where community members meet to discuss issues, although others were of the view that such meetings were for other issues such as crime and politics and did not focus much on fire and flooding:

> *There used to be, but gangsters are making people scared. We used to hold meetings about crime, fire and floods but some of our leaders got targeted in violent attacks. Now people are scared to even attend meeting.* (TLZ 090).

5.5 Lived experiences of fire in Overcome Heights

Fires in Overcome Heights spread rapidly because of the densely packed housing. The unpredictability of fire and the speed with which property is destroyed means it is experienced as a different kind of disaster and risk, compared to destructive flood events. A fire event takes place on the timescale of hours, but the immediate impacts ripple out over the next few days as people are at times forced to sleep outside until they can start to rebuild. There are also other longer-term impacts.

Before a fire event: causes and preparedness

Respondents in Overcome Heights largely saw settlement residents as responsible for fire outbreaks. Negligence was the most frequently reported cause (89%), and included illegal, faulty or insecure electricity connections, use of open flames such as paraffin stoves or candles, or explosion of gas bottles used for cooking. Drunkenness was identified by 46% of respondents as an important factor, leading to accidents such as knocking over open flames and negligence such as leaving stoves unattended. Arson was also cited as a cause of fires:

> *our neighbours were fighting and the woman burned the shack in a feat of rage, we lost everything because it started close to us.* (AM109).

Measures and actions identified that could be taken to avoid or mitigate fire in advance were limited to storing water and sand in houses.

During a fire event: impacts and coping mechanisms

Those who reported to have experienced fire in their house (69%) described loss of property and entire houses: '*My house burned to ashes. I lost everything because I was away at work.'* (AM 020). Respondents described emotions brought on by witnessing fire outbreaks, including confusion, shock, fright, panic and terror: *'I was very furious, angry and stressed not knowing how am I going to recover my assets'* (PN178). Others described an additional risk of loss of property as thieves took advantage of the situation:

> *We thought it was best to take out our stuff then help those where the fire was. In that chaos the thieves helped themselves to the items outside and even got into the houses to steal whatever they could.* (AM006)

All respondents said their health had been affected by the fires in some way, either physically or psychologically. Respondents knew of people being burnt to death or being killed through smoke inhalation in their sleep:

> *Fire causes many problems including death, people burn and die or get permanently maimed. The smoke from fire is toxic because so many different things get burnt.* (AM030).

Respondents recognised that some people were particularly vulnerable: *'In every community there are children and the elderly, these are usually victims of fire because they can't evacuate fast.' (AM002).* They also described respiratory issues such asthma and breathing difficulties. Psychological damage included stress, anxiety, panic attacks, living in fear and trauma:

> *It means we are not safe. Every day we have to sleep with one eye open just in case there's a fire and we have to get out of the house.* (CC193).

Despite these negative experiences, respondents also described a range of actions that they took during a fire event. Some of the immediate actions included calling emergency services and using sand and water to extinguish the fire themselves. Some mentioned creating fire breaks by dismantling houses close by to stop the spread of fire: *'I take my house apart so that my place doesn't catch fire and that the fire can't spread any further'* (CC186). Other actions included removing essential household items and assets and evacuating their homes. Essential documents (identity cards, passports, banks cards etc) and clothes were mentioned by 82% of respondents in Overcome Heights as the main items they would take in case of evacuation.

Unlike Sweet Home Farm, respondents mentioned emergency services responding to outbreaks of fire. However, because much of Overcome Heights is inaccessible to fire engines, these responses were not always helpful. Instead, respondents highlighted their reliance on community members – family, friends and neighbours – to deal with fire.

Also cited were issues such as limited water points to help tackle fire. Limited access and escape routes, the haphazard layout of the settlement and fire prone materials used to construct houses were also identified as key barriers to effective responses to fire. Finally, some respondents cited lack of knowledge on fire drills.

After a fire event: recovery and lessons learned

Immediately after a fire event, those who had been made homeless usually slept in nearby open spaces while waiting for assistance. Others were able to sleep in the homes of family,

friends and neighbours. They remained in this position until they obtained building materials, which were sometimes provided by the CoCT's Disaster Risk Management Centre (DRMC) but which may also have been salvaged from burned dwellings. Support from ward councillors, private sector organisations such as supermarkets and NGOs, in the form of basic necessities such as food, clothing and blankets were also discussed. Only a small percentage (8%) of respondents in Overcome Heights reported not having anyone to help sustain them after a fire event.

Repairing and rebuilding their home because of fire outbreaks – in some cases rebuilding twice was a common theme. Rebuilding was carried out by members of the household, sometimes with the help of family members, friends or neighbours. Household items and belongings that were damaged, destroyed or otherwise lost (e.g., because of theft) also had to be replaced and respondents highlighted the difficulties associated with the loss of these essential documents.

After every fire incident, street committee meetings were held to raise awareness of precautions that residents should take to avoid another fire. However, the effectiveness of these meetings were questioned, as not all residents follow the advice or agreed plans.

Over two thirds of respondents described having learned to take preparatory measures from their experiences of fire. The most important of these were storing water and sand in houses and packing essential items such as identity cards separately ready for evacuation.

6. Analysis

Our data reveal patterns of experience of and response to three different environmental hazards, each of which is likely to become more widely experienced as more regions feel the effects of rising global temperatures[2]. While the conditions in which each event unfolds are unique, our data provide illustrations of the ways in which the control and ownership of different forms of capital shape the capacities and agencies of household actors. They also offer some insights into how, against the background of these power structures, the experience of continuous risk and regular crisis shapes the habitus of these actors.

First, we make some observations about ownership and access to forms of capital in the three research sites. We then analyse the interplay of capitals and the shaping of habitus in each site.

6.1 Capitals: ownership and access

As noted above, the concept of capitals as enablers of resilience capacities is now relatively widespread in the literature on disaster risk and response (Bruneau et al., 2003; Cutter, Ash and Emrich, 2014; Dakhal, 2018; Gaisie, Han and Kim, 2022; Lakhani and Andharia, 2020; Mayunga, 2007; Yoon, Kang and Brody, 2016). However, different authors have deployed different sets of capitals and indeed interpreted particular capital types or categories in different ways. By focusing on households, our data highlight the importance of not only identifying different capitals that are brought into play in experiences of disaster, but also recognising and tracking ownership and control. Households (and individuals) may have

[2] It is worth noting that the lead author and her UK-based colleagues are writing this at a time when the UK has experienced temperatures above 40°C for the first time in recorded history, with many fire outbreaks occurring as a consequence.

ownership and control of cultural and social capital, as suggested by Bourdieu, in addition to economic capital, human labour and land. However, some other forms of capital may be, by social construction, always outside the (legal) ownership and control of households.

Of significant importance here are what has elsewhere been termed infrastructural and institutional capital (see, e.g., Lakhani and Andharia, 2020). In the CoCT region, and indeed in many cities and urbanized regions around the world, infrastructure such as roads, drainage, water and sewerage, electricity supplies and emergency services are owned and controlled by the state, local authorities and/or private corporate entities. Households and individuals can acquire access to them (and so to goods they deliver) through the "generosity" of the state, through the payment of taxes or fees or through illicit means. Control of these infrastructural capitals is thus outside the hands of households, unless normal power structures are bypassed or subverted. Similarly, institutional capital, understood as the services provided by NGOs, charities, private companies and the state (here, CoCT's DRMC) are owned and controlled by external actors. The goods and services controlled by these actors may be distributed to households and individuals, thus transferring some economic capital to the recipients, but households and individuals have no control over when, where and how these institutions operate. With this in mind, we now analyse the data obtained from each site.

6.2 Water scarcity in Delft South

The data from respondents in Delft South show how water scarcity impacts on many aspects of daily life. Aside from thirst and inability to wash, respondents described negative consequences for income generation and ability to observe valued religious practices. Water scarcity thus had the effect of decreasing some respondents' economic and cultural capital.

Delft South is a formal settlement and thus, as the responses confirm, households have access to infrastructural capital in the form of water, sewerage and electricity. Unemployment rates are lower than in Sweet Home Farm and Overcome Heights, and so respondents can also be assumed to have relatively high levels of economic capital compared to the other two research sites, although still low by overall standards. Despite having access to these capitals, it appeared that households felt powerless to act to *prevent* water scarcity. Ubiquitous media/social media messaging reminded them that the entire Western Cape was experiencing drought conditions and water supply challenges. Local exacerbations due to poorly maintained infrastructure were outside their horizons for action – no one suggested they had the power to fix the broken pipes in their locality. Instead, economic capital was expended in exchange for bottled water or bribes. Cultural (knowledge) capital enabled coping mechanisms to develop, and social capital encouraged distributed, supra-household responses.

However, no one openly questioned whether water shortages should always lead to universally restricted supplies. Complaints were largely directed at a perceived lack of effective communication rather than at policy or strategy. These relatively wealthy households appear to be relatively at risk of damage due to state control of the very infrastructural goods that contribute to their higher standards of living. Imposing a blanket restriction of 350l of water per household fails to recognize that some parts of the CoCT are at a pre-existing disadvantage and that households in other areas may be better equipped to purchase bottled water or to buy and make use of longer-term, larger-scale water storage

such as rainwater tanks. Yet none of our respondents described lobbying the CoCT to change its water restriction strategy. Instead, respondents described actions that reproduced and embedded existing power structures and inequalities, such as the paying of bribes or, perhaps most strikingly, the collection of water from communal taps in less formal and so less well-provisioned settlements. Relatively wealthy respondents were able to do this because of their car ownership; however this practice also relies on the existence of an underclass without piped water into their homes, who are effectively exploited as "their" water is taken by people who have perhaps already consumed their allocated 350l.

6.3 Flooding in Sweet Home Farm

Turning now to Sweet Home Farm, our data show that residents face multiple, complex and ongoing risks relating to flooding. Our respondents believed that their experiences have furnished them with the cultural (knowledge) capital needed to identify mitigation and adaptation measures, such as using cement to seal gaps and building steps to their homes, digging trenches and acquiring sandbags and other defences. However, they often lacked the economic capital and human labour needed to buy materials to carry out these mitigation measures.

An inundation may damage property and home, but respondents were also highly concerned about health risks. For residents of Sweet Home Farm, water and waste have become intermingled in both their thinking about flooding and in lived realities. This intermingling is a result of inadequate access to infrastructural capital, owned and controlled by the CoCT, in the form of good drainage, water and sewerage and waste management services. Sweet Home Farm does not have piped water facilities or sewerage and it is not possible to install these services because of the location and informal nature of the settlement. Potable water is available from communal taps; our respondents indicated that leaks from both the taps and the pipes that carry water are an additional cause of flooding, as well as heavy rains and the shallow water table. Without a sewerage system, or indeed without the appropriate geological structure to install one, as the survey responses confirm, almost all residents rely on communal toilets or chemical portaloos that have been provided to them by the CoCT. When these are broken, leaking or irregularly emptied, human waste mixes with the almost ever-present flood and standing waters, creating a public health risk. Sweet Home Farm does not have regular kerbside waste collection; as a result, household waste can also end up blocking storm drains, making flooding events both more frequent and longer-lasting.

As in Delft South, our data suggest that the histories and contexts of the residents of Sweet Home Farm combine with the distribution and ownership of different capitals to create a habitus in which coping, rather than changing or even escaping, is quite deeply entrenched. The absence of state or city level immediate response to a flooding event reinforces perceptions that flood is not disaster or shock but is rather part of the normal conditions to which people must adapt.

6.4 Fire in Overcome Heights

Similarly to Sweet Home Farm, the data from Overcome Heights reveal that residents experience several different, complex risks from fire. Aside from the obvious immediate risk

to property, buildings and life as fire spreads through a neighbourhood, our respondents describe consequential risks of property loss as a result of theft, either in the chaos of a fire or in the aftermath, when they have no alternative but to sleep outside in open areas. Equally, the data make it clear that health consequences go substantially beyond burns and smoke inhalation, extending to longer term effects including the impacts of trauma and anxiety as well as damage to people with pre-existing respiratory conditions.

The data suggest that the risk of fire is created and/or heightened by several factors. Although the most frequently cited immediate cause of fire was negligence or accident, another important reported cause was informal connections to electricity infrastructure. Just over 20% of respondents admitted to obtaining their electricity from a neighbour's house rather than through a formal, metered connection. Electrical faults associated with dangerous wiring and electrical connections were listed as significant causes of fire. Thus in Overcome Heights, the partial availability of infrastructural capital may be responsible for exacerbating fire risk, as residents without formal connections to the electricity grid create their own illicit and dangerous connections.

The impacts of fires, once started, were also likely to be made worse by the large number of dwellings partially or wholly constructed with timber (39%) and the dense housing concentration and narrow roads. This latter factor, mentioned by many respondents, has the effect of excluding many households in Overcome Heights from access to the infrastructural capital of emergency response services, as these employ fire trucks and other equipment that cannot physically enter or operate within these confined spaces. Emergency and community efforts to douse fires were also reported to be hindered by a lack of functioning fire hydrants and taps, once again illustrating the impact of infrastructural capitals that are outside the ownership and control of residents.

Compared to Sweet Home Farm, economic capital was less frequently mentioned as a barrier to recovery, perhaps because more support was made available to those experiencing fire from both the CoCT's DRMC and other actors such as NGOs and private companies. Our data suggest that initial recovery from fire events was largely dependent on access to institutional capital, outside the control and ownership of residents. However, longer term recovery, including the rebuilding of homes, depended heavily on respondents' own human labour and social capital, with family and friends helping with reconstruction. Residents' ongoing ability to generate income, and hence acquire economic capital, was also important in enabling them to replace damaged and destroyed belongings.

As with both the other sites, the histories and conditions of respondents in Overcome Heights seemed to have created, for many, a habitus in which the cycle of destruction and rebuilding is accepted as normal. However, unlike the other two sites, respondents also seemed to have developed a habitus of assuming personal, individual responsibility for fires, attributing blame to other residents or themselves, rather than recognising that there are significant structural causes. Respondents wanted more support, including psychological support for traumatic events, but seemed to have accepted that coping, rather than change, was their best and perhaps only strategy.

7. Discussion and Conclusions

In this section, we consider implications for both the CoCT and other regions that are experiencing or will experience similar ongoing environmental crises and socio-economic

living conditions.

First, we consider how a Bourdieusian capitals framework provides particular insights. Given that the residents experience recurring challenges, these marginalized communities go through cycles of preparing, encountering, and recovering from disasters over a period of time, based on seasons, weather conditions and chance. This cycle develops cultural capital in the form of knowledge acquired through experience. Across the three sites, most respondents felt they were able to rely on someone for support in the aftermath of a disaster, notably neighbours, family, friends and relatives. These support networks assist disaster victims with accommodation, food and psychosocial support. Thus, cultural and social capital are key to households' resilience. However, residents may become "trapped" in these recurrent disaster cycles because of dependencies on forms of capital that they neither own nor control. Delft South is a formal yet marginalized settlement, where external controls on water can allow scarcity to impact on already vulnerable and precarious residents. Sweet Home Farm is a deeply informal settlement, built in an area prone to flooding, and with hardly any infrastructural provision. Overcome Heights is also predominately informal, however with enough electricity infrastructure to both bring valuable utilities to households but also adding fire risk to those dwellings.

We observe that one of the most important capitals available to respondents across all three sites was cultural (knowledge). Simply having lived through and learned from a particular type of disaster before was a huge factor in enabling resilience or adaptive capacities. Cultural knowledge is also rapidly evolving as a coping mechanism for such events. This has important implications as the impacts of climate change spread and communities find themselves in unfamiliar territory.

Also important is the observation that the situations and experiences of respondents tended to limit their horizons for action and to shape habituses that reinforce or reproduce existing power structures. This is made clear where residents described being dependent on DRMC or repeatedly experiencing the same forms of loss, and even more so where they exploited their own more marginalized neighbours residing in more informal parts of their localities. This is not necessarily surprising given the constant exposure to risk and/or immediate experience of what we characterise as disasters but which have in fact become normality. Respondents' capacities and energy are likely to be devoted to actions directed at coping, leaving few reserves to take actions directed at change.

These findings are of potential importance to the CoCT's Resilience Strategy. As part of this strategy, the local authority intends to engage with communities to co-develop solutions that best address flooding and other socioenvironmental hazards in informal settlements (City of Cape Town, 2019). Identified gaps and areas of support needed to help build community resilience in the study sites can inform institutional planning and interventions which are applicable and relevant to these areas. The resilience strategy also calls for partnerships and resilience strengthening at all scales/levels including individual, household, community, neighbourhood and city-wide approaches. Our data reveal household coping strategies before, during and after disasters in the most vulnerable sectors of the city residential landscape. They also show the complex interplay of forms of capital and the importance of recognizing ownership, control and power structures. Lastly, they illustrate how repeated (and even constant) exposure to risk can shape a habitus of risk acceptance and a focus on coping rather than change.

These observations are important not only for Cape Town but also for other cities in middle- and low-income countries. They also remind us that a superficial use of the notion of capitals, divorced from a Bourdieusian sensitivity to power inequalities and habitus, limits what can be understood from the accounts of those who are already experiencing the impacts of the Climate Crisis on their daily lives.

Data uncertainties and Limitations

This study took place during the COVID-19 pandemic in 2020 and although the initial data collection plan was to undertake face to face interviews, this had to be altered to a telephone approach in order to comply with the COVID-19 restrictions and safety requirements. Such a change could have introduced a bias in the selection of respondents as their selection was based on community advisory board members resident in the study sites and the snowballing approach based on respondent referrals. The telephone interview process also had practical challenges related to e.g., network connection issues in some places and verifying with the respondents that they were eligible and able to participate in the survey. Also, the researchers could not witness and obtain the practical experience from visiting the study sites, as they had to rely on information shared by respondents. The use of the WhatsApp social media platform allowed respondents to share photographs depicting various issues in their area in real-time. For example, at the time of data collection, Sweet Home Farm was under floods and interviewees were able to share their own images of this challenge, through their own eyes and perspectives. In contrast, respondents in Delft had to base their responses on water shortages experienced during the water crisis period in 2018. However, despite these changes and challenges, the collected data provide an important baseline and insights on the lived experiences of the residents in the Cape Flats.

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‘It means we are not safe’: understanding and learning from household experiences of water scarcity, flood and fire in marginalized settlements in the Cape Flats, South Africa

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