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# Differentiated vulnerabilities and capacities for adaptation to water shortage in Gaborone, Botswana

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## ABSTRACT

Employing the heuristic of intersectionality, this study analyzes household effects and responses to water shortage in Gaborone, Botswana, focusing on residents' adaptive capacity and vulnerability. Using data collected through qualitative interviews, we find that households from all socio-economic backgrounds face various effects from water shortage and use numerous strategies to reduce exposure and impact. A key insight is that vulnerability and adaptive capacity are not equally distributed between, or within conventional social categories. Instead, the effects of water shortage are influenced by the intersection and interplay of several underlying factors.

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## KEYWORDS

Water shortage; urban water supply; vulnerability; coping and adaptation strategies; intersectionality; climate change

## Introduction

A prerequisite for life and underpinning livelihood opportunities, freshwater plays a pivotal role in society. The societal implications of its scarcity in relation to human development, population growth and climate change have long been discussed by scholars (Becker & Tehler, 2013; McDonald et al., 2011; Vörösmarty et al., 2000). Currently, around 4 billion people are experiencing severe water scarcity during at least one month per year (Mekonnen & Hoekstra, 2016), and approximately 844 million lack access to adequate drinking water (WHO & UNICEF, 2017).

This global water crisis is increasingly manifesting itself in the urban sphere, as rapid urbanization is outpacing the development of public services. The current 55% of the world's population residing in urban areas is projected to increase to 68% by 2050 (United Nations, 2018), and global water demand is projected to have increased by 55% (OECD, 2012). This is indeed alarming, as a quarter of large cities already face water stress (Padowski et al., 2016). The interplay between climate change, natural water variability and availability, and societal water demand and supply in urban settings is highly complex and site-specific (Jiménez Cisneros et al., 2014).

In Gaborone, the capital of Botswana, climate change and demographic trends are projected to present a significant challenge for freshwater provision. In this semi-arid region with high susceptibility to periodic drought, climate change has already raised the average temperature 1 °C from pre-industrial levels (Nkemelang et al., 2018). Annual precipitation of 416 mm/y and evaporation reaching as high as 2000 mm/y results in

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low groundwater recharge and surface runoff (Juana, 2014; Segosebe & Parida, 2006), limiting opportunities for water storage; the country has struggled with water shortage for decades (Ganesan, 2001; World Bank, 2010). This is compounded not only by climate change but also by increasing water demand due to progressively higher living standards and industrial growth (Hambira et al., 2011). In 2015/2016, Botswana had its most acute drought in over 30 years, severely straining the domestic water supply. In Gaborone, the level of water behind the dam supplying freshwater fell well below 20%, putting the city on the verge of running out (New & Bosworth, 2018). Experts are expecting similar events in the future (Hoegh-Guldberg et al., 2018).

Despite the current and anticipated rise in urbanization and resulting vulnerability, the literature on climate change adaptation in developing countries is geographically biased towards rural areas (Schaer, 2015), focusing on poorer communities, and often with only sex-aggregated data when studying differentiated adaptive capacity (Eriksen et al., 2005; Quinn et al., 2011). Considering people as active agents with varying opportunities and constraints, rather than merely passive victims of circumstance (Eriksen et al., 2005), it becomes crucial to understand dynamic socio-ecological interaction in the urban domain, since adaptive responses become vital as the impact of climate change unfolds, regionally and locally (Berkes & Jolly, 2001). Case studies on water shortage in Botswana have focused on rural communities in the northern regions (Kujinga et al., 2014). Hence, adaptation and vulnerability to water shortage in the urban setting of Gaborone remain insufficiently researched, despite the increased urban water shortages, epitomized by the Cape Town water crisis in 2017/2018. The purpose of this article is thus to address this gap in the literature by exploring household effects of and responses to water shortage in Gaborone, with special attention to the differences in adaptive capacity and vulnerability of residents. A qualitative case study was conducted in Gaborone, applying intersectionality as a heuristic device – an increasingly used approach to analyze complex context-specific issues (Cho et al., 2013). We thus set out to answer two research questions:

- What are the effects of water shortage on the residents of Gaborone?
- What are the underlying factors influencing these effects?

## Conceptual framework

Several concepts are used for freshwater availability issues, e.g. 'water scarcity', 'water shortage' and 'water stress' (Falkenmark, 1989; Shandas et al., 2015; Vairavamoorthy et al., 2008). Some sources distinguish between these concepts (FAO, 2012), and others use them rather synonymously. Here we use only 'water shortage', this being the phrase used by the research participants to describe a situation in which they are faced with insufficient supply of and access to clean freshwater in relation to their needs. This embeddedness of the concept in everyday language is valuable as it encodes the practical experiences of the speakers as well as the collective knowledge on which its usage is founded (Hearn, 2012).

Another central concept for this article is 'adaptation', which is often defined in relation to climate change as 'the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities' (IPCC, 2018). A concept closely related to adaptation is 'coping', here defined as 'the ability of people, organizations

and systems, using available skills and resources, to face and manage adverse conditions, emergencies or disasters' (UNISDR, 2009). Although some conceptualizations of adaptation include such coping (Becker et al., 2016), coping strategies are typically reactive and immediate responses to an event, while adaptation often refers to long-term strategies that can be either proactive or reactive (Berkes & Jolly, 2001). Thus, although coping strategies can increase a household's ability to withstand immediate threats, they neither serve as long-term solutions, nor do they reduce future vulnerability. Frequent use of coping strategies can instead have adverse effects, as they may deplete resources required for future coping or for investment in adaptation (Adger, 1996). However, the two types of strategy may overlap, and coping strategies can develop into adaptive strategies over time (Berkes & Jolly, 2001). Also, in the context of this article, it is important to keep in mind that people do not only cope or adapt to climate change per se but rather to a complex combination of factors that are changing in their immediate environment, including service provision (Lama & Becker, 2019; Parsons & Nalau, 2016).

The choice of strategy for coping or adaptation is not isolated from other decisions but is constrained by institutional processes, regulatory structures, property rights and social norms (Adger et al., 2005). The interplay of these complex factors thus influences the adaptive capacity of the household, which greatly influences its vulnerability (Smit & Pilifosova, 2001). 'Vulnerability' is here understood as susceptibility to harm in relation to specific events (Becker, 2014). While studies have highlighted the importance of social differentiation as a crucial determinant of vulnerability (Adger & Kelly, 1999), traditionally, the literature on vulnerability has identified entire groups of people as inherently vulnerable, irrespective of the stressor, for example women, children, the elderly, persons with physical or mental illnesses, or indigenous peoples, to name but a few (ESCAP & UNISDR, 2012; Morrow, 1999). However, this view of vulnerability as a homogeneous property of social groups is misleading, as it ignores differences in both exposure and susceptibility within each group, as well as the underlying reasons that certain people in these groups may be vulnerable in the first place (Buckle, 1998; Djoudi et al., 2016).

While it has long been noted in the climate change adaptation literature that a person's vulnerability is shaped by several factors, such as race, gender, age and so forth, what is less studied is the intersectionality of these factors. Drawing on feminist research (Crenshaw, 1989; Osborne, 2013), an intersectional framework recognizes that it is the interplay of these factors, together, that shapes an individual's position and how they experience space and place (Fagertun, 2017; Kaijser & Kronsell, 2014; Osborne, 2013; Thompson-Hall et al., 2016). The intersectional approach remains novel in climate change and vulnerability research (Djoudi et al., 2016; Kaijser & Kronsell, 2014), but it sheds light on how the 'responsibility, vulnerability, and decision-making power of individuals and groups in relation to climate change can be attributed to social structures based on characteristics such as gender, socio-economic status, ethnicity, nationality, health, sexual orientation, age, and place' (Kaijser & Kronsell, 2014, p. 420). This makes it possible to ask questions concerning how particular positions enable and constrain individual agency (Kaijser & Kronsell, 2014) and permits a more robust understanding of dynamic assemblages of power and how these shape vulnerability and adaptive capacity (Thompson-Hall et al., 2016). In this article, intersectionality is used as a heuristic, guiding the analysis by providing a lens through which the data is analyzed.

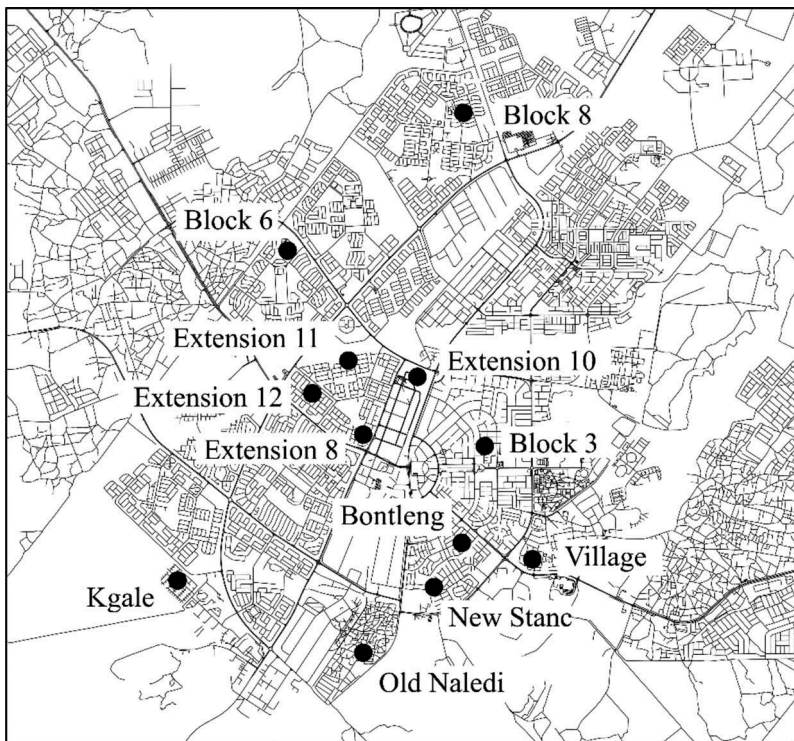
## Methodology

Given the exploratory character of the research questions, a qualitative case study with an inductive approach to the relationship between theory and research was deemed suitable, as it provides for individual perspectives to constitute meaningful information in the pursuit of new knowledge on the micro level (Bryman, 2012; Yin, 2011). The choice of Gaborone rested on a combination of factors. The researchers had previously worked in Botswana and were visiting during the severe drought of 2015/2016, which sparked an interest in the topic of household adaptation to water shortage. The Inter-governmental Panel on Climate Change (IPCC, 2018) has projected that Botswana, alongside Namibia and parts of South Africa, will have the largest increases in temperature in the coming years, causing droughts and water shortage. And Gaborone is what Bryman (2012) refers to as an exemplifying case of household adaptation to urban water shortage in semi-arid Africa, as there are several semi-arid cities across Sub-Saharan Africa that are experiencing similar changes in climate.

The city of Gaborone is characterized by rapid urbanization and development stemming largely from extensive public and private investments and rural–urban migration (Rankokwane & Gwebu, 2006). While the development of recent decades has brought economic prosperity and urban development to the city (currently of 234,000 inhabitants), socio-economic inequality persists, as economic growth has not been accompanied by commensurate increases in formal sector employment opportunities (Rankokwane & Gwebu, 2006). This has resulted in, among other things, significant food insecurity among the less affluent households (Acquah et al., 2014) and continuous health struggles related to the HIV/AIDS epidemic (Ritsema, 2008). An estimated 97% of the national population have access to an improved water source (WHO & UNICEF, 2015), and water provision is governed by the parastatal Water Utilities Corporation (WUC).

Data were collected through 58 semi-structured interviews in January to March 2019. Semi-structured interviews were deemed appropriate, as they allow participants to influence the conversation and candidly express their own ideas and perceptions (Bryman, 2012). There were 55 primary interviews with residents and three key informant interviews with professionals working on climate change adaptation, healthcare services and marginalized population groups. The participants in the primary interviews were selected through snowball and purposeful sampling of both neighbourhoods and participants (Bryman, 2012) in 12 different areas across Gaborone (Figure 1). To elicit information in different socio-economic contexts, across differing gender, age, nationality, and locations, a local professional researcher, functioning in part as a cultural guide, helped in the preselection of neighbourhoods to ensure diversity of characteristics and perspectives in the sample. The interviews were collected by a combination of scheduled interviews and going door-to-door in the preselected areas.

Key informant interviews were included primarily to provide complementary perspectives to the primary interviews on particularly sensitive issues. For example, HIV/AIDS is a fundamental aspect of society in Botswana, with an estimated 20.3% of the population being HIV/AIDS positive (UNAIDS, 2017). However, societal stigma makes many HIV/AIDS-positive people not want to openly discuss this and makes it inappropriate to openly ask people about their health status. Thus, key informant interviews were deemed



**Figure 1.** Map of Gaborone and sampled neighbourhoods (adapted from ID 127737740, © Vampy1, Dreamstime.com).

appropriate and necessary to ensure that the perspectives of this and other marginalized population groups were included in the data set.

Interviews were conducted in either English or Setswana, depending on the preference of the interviewee. Interviews in Setswana were conducted with the help of the professional researcher, as an interpreter. The primary interviews included demographic questions (self-identified gender, age, marital status, nationality and ethnicity, household level of education, employment/livelihood, family structure, and housing tenure) and three interview themes (climate change, household water system and water shortage). The key informant interviews covered three themes (effect on organization/work activities, effect on local community, and vulnerability and adaptive capacity). The interviews were recorded and transcribed.

Data were analyzed using a grounded theory coding methodology (Charmaz, 1996; Glaser & Strauss, 1967; Hahn, 2008) and the computer software NVivo. This inductive strategy for data coding and analysis was chosen as it makes possible, through an iterative process of data disassembly and reassembly, to gradually develop increasingly abstract conceptual categories and themes and discern patterned relations (Charmaz, 1996). Three levels of coding were conducted, from coding line by line, through concepts, to broader categories (Table 1). Using NVivo also made it possible to create cases out of each of the transcripts and assign each to various classifications, which is helpful for intersectional analysis.

**Table 1.** Coding example.

Level 1: line by line	Level 2: concepts	Level 3: broader categories
'We used to bathe with 9 L, then it's going to reduce to 6 L or you share that 9 L with the small kids.'	Changing routine – water conservation	Coping and adaptation strategies

A potential limitation to this methodology, if left unchecked, is the researcher's own predetermined expectations of the data. To ensure that the analysis is *grounded in* rather than *imposed on* the data, it is imperative to remain open-minded throughout the research (Kolb, 2012; Kushner, 2003). Similarly, there is a potential for bias in the sampling plan, if this is not considered from the outset (Kolb, 2012). Combining purposeful and snowball sampling helped ensure that the study gained as broad perspectives from the participants as possible to enable a study of intersectionality. Acknowledging this limitation further motivated the choice of combining primary interviews with key informant interviews to give voice to vulnerable and marginalized population groups whose experiences would otherwise not have been represented. It is important to note that while the study sought broad and differing perspectives in the sampling pool, it does not claim to be representative. The focus on analytical rather than statistical generalizations further influenced the choice of not always presenting the precise number of participants behind particular findings. Such numbers can be misinterpreted as statistical material and shift focus from the qualitative evidence to the amount of evidence for our analytical generalizations, confusing precision with validity (Maxwell, 2010). We thus adhere to the conventional qualitative research approach of also presenting amounts of participants in qualitative terms, while raw data may be presented in numbers.

## Results

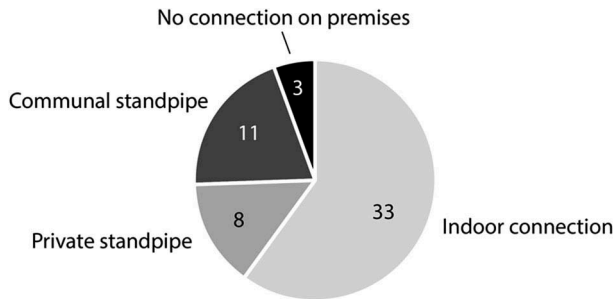
We present the findings under the six topics that emerged as the main categories of the analysis: water access and water shortage experiences; coping and adaptation strategies; disruptions of lives and livelihoods; health challenges; social exclusion and embarrassment; and intersecting barriers to adaptation.

### *Water access and water shortage experiences*

For all 55 of the participants of the primary interviews, the WUC is their principal source of water. But the type of access varies between indoor connection, private standpipe, communal standpipe, and no connection on the premises (Figure 2).

Many neighbourhoods in Gaborone have a combination of low- and middle-income housing. High-income neighbourhoods seem more secluded. Thus, residential areas often include households with varying access to water, depending mainly on their socio-economic background and housing tenure. For example, 22 of the 33 households with an indoor connection own their housing, but all the participants who access water through a communal standpipe rent their housing.

Only one participant reported never having experienced water shortage while living in Gaborone. The other 54 participants have all experienced water shortage at least once. The



**Figure 2.** Types of water access among the 55 participating households.

participants described water shortage as water cuts (both announced and unexpected), water rationing, and undesirable water quality. In the interviews it becomes apparent that shortage is not experienced uniformly. In some neighbourhoods, water rationing brings completely dry taps; in others, only low water pressure. Further, according to the participants, the duration of shortage differs across neighbourhoods, ranging from a few hours to several weeks. Area-specific patterns are difficult to discern because even participants from the same neighbourhood had different experiences. Participants who reported that their neighbourhood was less affected by water shortage compared to other places had various explanations, including proximity to ministers, government officials and embassies, businesses, hospitals, or the Gaborone Dam, or being connected to the primary water infrastructure grid.

### ***Coping and adaptation strategies***

For all the households experiencing water shortage, access to clean water is a priority. One participant said, 'You can regulate your life around that there is no electricity, but you can't regulate your life around there being no water. No, water is hygiene, water is life, hydration, cooking, washing, you know, water is absolutely important.' The households use various strategies to reduce the risk of water shortage (Table 2).

Most of the strategies are reactionary: primarily about coping rather than adapting. Thirty-three participants describes various methods of water conservation, including new routines for bathing, laundry and cooking, as well as water reuse. Another coping strategy is to use alternative water sources. Twenty-one participants reported buying water, which is further described below. Twenty-five said that as a last resort they get water from friends, family, neighbours, colleagues, or fellow church members. Nine turn to formal institutions, such as schools and universities, or their workplace. These strategies are used by households of both low and middle socio-economic status. Rainwater harvesting, whether by collecting it in smaller buckets or by investing in structural equipment, is a strategy 17 households engage in. Investment in structural equipment includes the installation of greywater systems or connecting a water tank to the municipal water infrastructure. Only eight participants had done this.

Storage is the most used risk reduction measure, with only five participants declaring that they do not store water and thus rely only on tapwater or purchased water. Water is stored in variously sized containers, including buckets, drums and JoJo tanks. If the timing



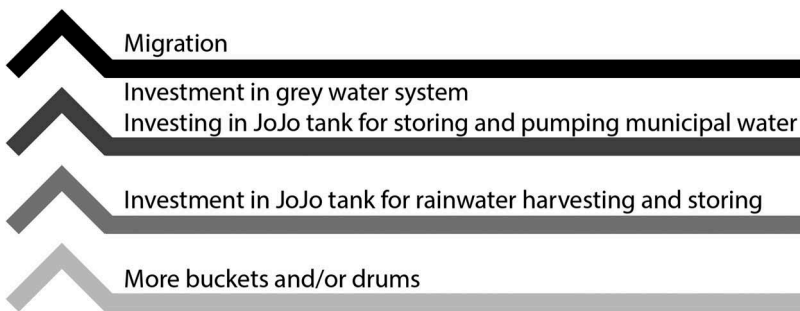
**Table 2.** Household coping and adaptive strategies.

Overall strategy	Sub-strategy	Strategy characteristics	Number of participants, sub-strategy	Number of participants, overall strategy
Water conservation	Changing routine	Reactive	17	33
	Reuse	Reactive	19	
Storing		Anticipatory and Reactive		50
Investment in structural equipment		Anticipatory		8
Alternative water sources	Purchasing	Reactive	21	43
	Rainwater harvesting	Reactive	17	
	Social network	Reactive	25	
	Official institutions and work	Reactive	9	

is right, storage can minimize exposure to water shortage. And all of the 22 participants who lacked an indoor water connection stored water to save time, irrespective of water shortage issues. But even though their average storage capacity is only a few buckets (of 20–25 L each), it also reduces their vulnerability to shorter unanticipated water cuts. Twenty-two participants continuously store water as a precaution, as they ‘always have to be prepared’, since they ‘never know when water will be cut off’. The other six participants who store water only do so reactively, as a coping strategy, after they experience low pressure or have been informed in advance of possible problems with the water supply.

When asked about their perceived needs to increase their adaptive capacity and reduce vulnerability, with only few exceptions, the long-term adaptation options the participants describe appear to be hierarchical and informed by their current means of coping and adaptation, coupled with their socio-economic status (Figure 3). For example, participants with only a few 20–25 L buckets said that their preferred long-term adaptation would be extra buckets and perhaps a drum. Participants with both buckets and drums said that they would want a JoJo tank for rainwater harvesting; and so on.

The main exceptions to this hierarchical set of perceived adaptation needs concerns the top category, migration (Figure 3). Although eight participants had invested in structural equipment, migration was mentioned by only three, of varying socio-economic



**Figure 3.** Hierarchical order of self-identified long-term adaptation options.

status. All three described it as the last resort. The ones with lower and middle socio-economic status, who had not already exhausted the adaptation options above, considered moving from Gaborone to another part of Botswana. One explained:

We are kinda at that point whereby we can no longer put water in every household. It makes me really scared. Even wanting to move out has already been part of the ways in order to get water elsewhere. Move out of Gaborone and go maybe up North where there is plenty of water.

The limited job opportunities outside the city would make such a move challenging, as the household would have the added cost of commuting to the city for work every day. One of the participants said he was not sure he could afford it, making migration the last resort. On the other hand, the participant with high socio-economic status referred to moving out of Botswana, and said it might be inevitable:

So long term the viability of Botswana as a country is problematic. And for me, being a father, long-term I am thinking, you know, when my daughter is my age, will this be a viable country for her to exist in? I have a strong feeling that Botswana is gonna be one of the places where we become climate refugees... So, part of my long-term planning is to make sure that if we had to emigrate, my family would have the resources to do so.

### ***Disruptions of lives and livelihoods***

When discussing how water shortage affects their households, most participants brought up the disruptions of daily life. Minor but more frequent cuts, lasting from a couple of hours to a day or two, strongly affect what you can cook, and other everyday chores: 'I was busy washing my clothes. When I got there, no water. Ah. I just had to stay and wait for it to come... So that day I had to stay home', a young woman recalls from the day before the interview. More severe water shortage, following a drought, also affects how many times you can cook in a day and how you spend your days and nights. A participant from Old Naledi, a low-income neighbourhood, said that during the 2015/2016 drought his area got no water. People had to travel at night to other neighbourhoods to fetch it:

During the day there was no water, so we had to be there all night in the queue, somewhere in the government schools or in the government departments or sometimes in the industries, in the shops... We will go there around 12 o'clock, midnight, and be there until four. In a serious queue, people are coming from different areas. We are there, in the queue. Yeah but the little that we get, it was important."

In other areas, during the drought, water was available only during the night, until around seven in the morning. Since women are commonly responsible for fetching water, the rationing disproportionately affected female participants' sleeping patterns: several mentioned that they had to wake up between three and five at night to gather water to store for the following day.

Eleven participants described how water shortage undermines livelihoods. Thus, many use risk-reducing measures, including storing water and reducing their dependency on water, for example by selling food that takes less water to prepare, or by replacing hoses with buckets when cleaning cars and automobile parts. Changing jobs is not an option for everyone. A Zimbabwean man from a predominantly poor neighbourhood explained:

Ah, eish, we are limited. We are very much limited ... because mostly they will tell us we are not a local person. They say, 'You want to do a better job than the one you are doing?' They tell you this one is reserved for Batswana.<sup>1</sup> ... The truth is I am limited, especially in terms of jobs.

As his statement illustrates, the intersection of nationality and low socio-economic status limits a person's capacity to diversify income, even if it is necessary. He said that this happened to many of his other non-national friends, when they found themselves unable to continue working as gardeners during the drought, as a result of the water restrictions imposed by the government.

Similarly, eight participants with Botswana citizenship but with low socio-economic status said that their livelihood depend on their cattle posts (rural place where urban dwellers keep cattle) and government-allocated plots of land outside Gaborone. Five of them rely on the land to reduce food spending and to supplement household income with small-scale vending. The other three, all between 50 and 75 years old, have only subsistence livelihoods. Two are retired. Another is too sick to work and so totally depends on his cattle post. He said that we was struggling to survive after losing most of his animals during the 2015/2016 drought.

In the interviews, it thus becomes apparent that a recurrent theme among many of the participants is the disruption of daily life and livelihoods. But during smaller water cuts these are not as severe as the sustained and prolonged adjustments to everyday life caused by more severe periods of water shortage, such as the 2015/2016 drought.

### **Health challenges**

Twenty-four participants expressed concern regarding the health effects of drinking municipal water. Some had experienced stomach ache or diarrhoea after consumption, while others were put off by poor taste, colour or odour. Previously, the water in Gaborone had been safe to drink, but a key informant asserts, 'We know that the actual water in the tap right now is not reliable.' There was an outbreak of diarrhoea in 2018 that, according to the Ministry of Health & Wellness, was associated with drinking water provided by the WUC (Kgamanyane, 2018). However, the WUC has denied all responsibility and maintains that the water is safe for human consumption (WUC, 2018). Several participants expressed frustration over the uncertainty and contradictory statements; one participant said, 'Water Utilities insists that the water is clean, but the Ministry of Health has gone on the radio and newspapers to warn us to boil water.' This frustration had led to an overall lack of trust in public authorities among six participants.

The diarrhoea outbreak mostly affected children under five, and caused the premature death of at least 31 children (*Sunday Standard*, 2018). Twenty participants from varying socio-economic backgrounds, 15 of whom were living with children under five, described measures like boiling municipal water or buying potable water. A father of three young children said:

We have stopped drinking this water from Water Utilities after that outbreak of that bug which attacked. Because my, my, all my kids, they nearly died from that. They got attacked by that bug, then I took them to private hospital, Gaborone private hospital, that is where they found out: No that is this borne disease from the drinking water they were drinking.

Buying water is a luxury not everyone can afford. Several households with low socio-economic status had found ways to finance it by compromising on other household utilities, most commonly by buying less meat, which is an expensive but traditionally significant food item. Still, many participants consider boiling water too tedious, even though they are aware that it reduces the risk of getting sick. Some boil the tap water only when the notice poor taste, odour or colour, or when the media report on suspected outbreaks.

While citizens can access the healthcare system, a key informant in the health sector stressed that non-nationals with lower socio-economic status (legal and illegal) are more vulnerable. They can seldom afford to buy potable water, and it is not uncommon that 'they get turned away' from the hospital and clinics 'because they don't have papers or they don't have enough days on their passport. And when I say turned away, I mean turned away. They have nowhere they can go.'

To fight the HIV/AIDS epidemic, the state provides free antiretroviral therapy for all citizens. A key informant working with people living with HIV/AIDS explained that water shortage can endanger this community, as water is required when taking the medication.

People can't take their meds if there is no water. Water rationing, it affects the times that people take their medication. It means sometimes if you didn't keep water, you have to wait for the time that the water comes back. That's when you take your medication, by then. And then it affects your health and the treatment and how it will work in your body.

This risk to a person's health may have further cascading effects. A key informant from the healthcare sector explained the relation to potential HIV transmission to babies through breastfeeding: 'So with breastfeeding, if your parents are undetectable, in other words, they take their medicine properly, it should be safe to feed their baby.' But if a breastfeeding mother is unable to properly medicate, it may affect not only her own health but also the health of her baby. The key informant also mentioned an additional disadvantage for poorer non-nationals: the government provides the free antiretroviral therapy only to citizens. Also, non-national HIV/AIDS-positive mothers who cannot afford medicine depend on formula to prevent transmission to their babies, but this requires milk or water, which in turn requires money or increases vulnerability.

### ***Social exclusion and embarrassment***

When talking about the effects of water shortage, 25 participants states that it influences bathing routines, including changes in form (using tubs or buckets instead of showering), volume (using significantly less water) or frequency, reusing or sharing water, or skipping showers altogether. A mother said that she prioritizes purchasing sturdy clothes and limits her children's outdoor playtime:

You see my kids are playing inside the house. I am avoiding [having them] to go outside, to play outside, because if they get dirty, I am going to use a lot of water... If they break the cup, I can buy a cup, but you can't, I can't provide water.

Several participants explicitly stated that they deprioritized laundry; many would wait up to several weeks during periods of severe water shortage. All but two of these were women. Although laundry was typically mentioned as being the last priority during

extended water shortage, some women from low socio-economic backgrounds responsible for school-age children felt differently. A mother explained: 'We had to clean up the uniforms so that the kids can go to school clean. Uniforms have to be cleaned every day.' They said that 'if the uniforms are not clean, the kids will be sent home. Or the school will call the mother and have her come and pick up her child, which is very embarrassing and socially not good.' In addition to potentially impeding the children's education, the gendered societal norms pertaining to house chores put additional strain on women, who are usually responsible for access to water and for water-intensive domestic labour.

A few young participants said that having to change their hygienic practices made them 'feel embarrassed to go out', as 'you can't go out without having bathed'. This leads to isolation and social exclusion because of the prospect of embarrassment and ridicule. A key informant said that body odour is 'quite unacceptable' in Botswana, and that smelling bad would affect daily interactions, even reducing the chance of getting a job if unemployed.

Several participants of middle socio-economic status noted social consequences from investing in expensive risk-reducing equipment, e.g. large JoJo tanks. While these households can afford such investments, they often come at a cost to their social life. One participant, who had purchased a big JoJo tank in the 2015/2016 drought, said:

We had to cut certain things, for us to buy those things. Like, we used to go out, have fun, run around and stuff like that, right? But ever since we thought of buying this [points to the JoJo tank], we had to cut certain things ... because we felt that having fun while you have no water makes no sense. So, we had to cut that.

Studies have previously shown that many people in Gaborone maintain strong links to their ancestral villages and their respective communities (Krüger, 1998; Lesetedi, 2003), which are increasingly strained by the impact of water shortage. A woman participant said:

Basically we are just living to survive... We had to cut everything that we do not need to survive with. The first thing we had to cut was the travel.: So you literally change your social life. Which means you change your social standing in your own community. Because we come from Kgatleng, Kgatleng still has, especially in smaller areas, they still have this [traditional *kgotla* events and meetings], and now if you are not there, ultimately you don't belong. So you find yourself having to work overtime to remind the community, 'I am still a member of this community.' And if you have come in, like me, from somewhere else, it's even more taxing for me. Like if there is a funeral in his place, he would not have to stay, but if I don't stay, then I am not – you know what I mean? So there is quite a lot that we have to cut.

Thus, the impact of water shortage is also felt within local communities, threatening traditional social norms and customs, which adds another kind of pressure for people to uphold them. Even if they face the same choices, people are affected differently, due to different expectations, on the basis of their gender and whether they were born into or married into the community. Similarly, women of low socio-economic status who are responsible for school-age children face a strong societal pressure to send their children to school clean and tidy, which alters household water priorities.

### ***Intersecting barriers to adaptation***

The ability to buy water, to be mobile, and to buy supplies and equipment are essential for all participants, irrespective of socio-economic status. As a wealthy male participant explained: 'I need my family to survive climate change. And the best way to do that, unfortunately, is to not be poor. That's the cold-blooded truth.' Similarly, but from the viewpoint of less affluent households, not having enough money 'is a problem', because if you cannot afford to invest in adaptive strategies (e.g. storage tanks), it means that 'you are doomed'. For all but a few participants, money is a substantial factor in why many participants with middle and lower socio-economic status struggle to adapt to water shortage. While almost all had ideas on what they would need, as presented above, many cannot afford such investments. However, the issue is not only socio-economic. Nationality significantly influences an individual's ability to diversify income and increase adaptive capacity, and so does gender and age, as well as employment status and housing tenure.

Among the 24 households with children five or younger, only women mentioned that young children hindered their ability to improve their financial situation. This reflects how, in Botswana, childcare is predominantly women's responsibility. Lower socio-economic households cannot afford to outsource childcare, and the women in the family have to care for the children.

This affects grandmothers as well as mothers. One grandmother said that she retired from being a seamstress after assuming the responsibility of caring for her grandson. A young single mother of low socio-economic status further explains how the priorities of childcare impede other investments: 'I am not comfortable. I would buy a bigger tank to store water, but it is not something I am prioritizing to save up for yet. There are other priorities with the baby.' She said that any extra money was used on potable water for her baby and his formula, as 'it is better than the tap water'. Fear of contaminated water makes her spend money on coping mechanisms, hindering her ability to engage in long-term adaptation. How gender affects an individual's adaptive capacity was also stressed by a key informant working on climate change adaptation.

The key informant also pointed to age as an influencing factor. Being young limits a person's adaptive capacity to water shortage, as they have no arable land or notable savings. The narratives of the participants under 30 – living alone, with a friend or a partner – reflect this sentiment. Seven households fit this description, from both low and middle socio-economic backgrounds, and they have limited resources to reduce vulnerability against water shortage, only using 5–25 L buckets for water storage and all living in rented housing. Several explained that they are unable to improve their financial situation due to being either students or unemployed, though they hoped to invest in equipment once they had a secure income.

Although the unemployment rate is generally higher among the younger population (Mogomotsi & Madigele, 2017), unemployment was an issue facing participants of all ages. An unemployed middle-aged man from a poor neighbourhood summarized his outlook on the future by saying, 'If it's time to die, it's time to die, man.' Aside from the harsh words, this statement reflects a sentiment felt by many of the participants – that they have little agency to improve their situation, and can do little but pray for better times.

Many adaptive responses to water shortage require either land ownership or structural changes to the property, so renters seldom engage in such measures. For the two participants residing in apartments, adaptation options were limited, with neither access to land nor direct control over the building structure. For the participants renting a house on a plot of land, lack of land ownership was cited as a common barrier to adaptation through investment in structural equipment, with responses such as ‘it is not my house ... so ... I am not even considering doing that’ or ‘because I don’t own the property ... it would be a really big optional extra’. Housing tenure thus significantly influences a household’s adaptive capacity, as renters are generally unwilling to invest in structural equipment and thus long-term adaptation.

## Discussion

### *A nexus of effects, coping and adaptation in relation to water shortage*

Access to improved water, sanitation and hygiene is a key component in healthy living and quality of life. All the studied households have access to an improved water source, which is in line with the national estimate of 97% of the population (WHO & UNICEF, 2015). On the other hand, all but one of the participating households have been affected by water shortage, at least once – even in Gaborone, where the water supply is considered the best in the country. This is consistent with the notion that statistics on ‘access to an improved water source’ are a poor measure of households’ relationship to water and water shortage in many contexts where reliability is an issue (Adams, 2017; Kujinga et al., 2014).

The findings are rife with examples of how water shortage disrupts daily life in behavioural, spatial and temporal terms. The participants describe significant changes in household chores, increased needs to move around to fulfil their needs, and more time spent on accessing water. Many alter their daily routines, depending on the severity of the shortage, for example being up very late or very early to fetch water, or having to spend more time fulfilling their needs. Water conservation is also an important coping strategy, mainly through altered hygienic practices and closing water-intensive businesses. While changing routines is a commonly identified coping strategy (Smiley, 2016; Thompson et al., 2000), it is difficult to find accounts that include the associated loss of livelihood. Similarly, household water storage, another important coping and adaptation strategy, is commonly found in both our findings and the broader literature (Smiley, 2016; Thompson et al., 2000) but is likely to also affect water quality, as untreated bacteria in buckets and tanks frequently lead to water-borne diseases (Feleke et al., 2018). Thus, although all our participants blamed health challenges such as stomach ache and diarrhoea on the poor quality of the water provided by the WUC, it is important to note that they could have other causes. In this study, these health challenges were particularly present among households with small children, who then engaged in risk-reduction measures. And while this finding supports the available theory (Prüss et al., 2002), and the link between water shortage and water quality has been established in other studies (Arnold et al., 2013; He et al., 2018), more research into the relation between these health challenges and water quality is needed if we are to better understand the complexities surrounding water shortage in Gaborone. Still, water shortage can have disastrous effects on people

with serious illnesses, particularly the many who are HIV/AIDS positive, since access to clean water is required for their medication.

We also see effects of water shortage in relation to social exclusion and embarrassment of individuals not managing to uphold the socially required hygienic standards, which may limit their mobility and isolate them socially. This is in line with Curtis et al.'s (2009) review of studies from 11 locations around the world, which found that being unable to wash or bathe made it difficult to be fully accepted and respected in those societies. In our research, social exclusion for violating social hygienic standards seems to be especially problematic for young people, although more research is needed to establish the extent of the issue. The findings also indicate that caregivers, in this case women caregivers, are particularly subject to social stigma if they are unable to meet the hygienic standards for their children, consistent with a study in urban India (Reddy & Snehalatha, 2011).

### ***The intersectionality of underlying factors***

Poverty is often identified as the primary driver of vulnerability and lack of adaptive capacity (Smit & Pilifosova, 2001). However, labelling all less affluent households vulnerable based solely on their socio-economic position is misleading. We find that vulnerability and adaptive capacity are not uniformly distributed either between or within social categories. For instance, some of the poorer households renting accommodations without an indoor water tap are less vulnerable to shorter unanticipated water cuts due to their preestablished practice of storing water, even if it is done primarily to save time rather than to reduce risk. All but one of our participating households are impacted by water shortage, albeit in different ways. While access to resources is important, applying an intersectional lens enables a much broader analysis, where it is possible to look at the underlying, intersecting factors that shape adaptive capacity and vulnerability among the participants: identity markers related to gender, age, nationality and socio-economic structures, as well as contextual factors of health, caregiving, employment status and land and housing tenure.

For instance, women and men are affected differently by water shortage, even if they live in the same household. Women are expected to ensure that the household has access to water, and to perform many of the water-intensive household activities. This finding is consistent with previous studies on gender and climate change adaptation and water shortage (Djoudi et al., 2016; Gambe, 2019; Terry, 2009). But we also see vast differences among the women. Vulnerability and adaptive capacity differ for female caregivers with young children, versus women without such responsibilities. Irrespective of socio-economic background, being a primary caregiver exacerbates the pressure to find sustainable solutions to substandard water quality and to uphold social norms of cleanliness and hygiene, especially for the children. When intersecting with lower socio-economic status, these responsibilities further limit women's ability to take employment, which in turn constrains their access to the financial means needed to cope and adapt. We also see that being HIV/AIDS positive exacerbates the effects of water shortage, as access to clean water is a necessity for antiretroviral therapy. This vulnerability is exacerbated for HIV/AIDS-positive breastfeeding mothers, as clean water is essential not only for their own health but also for the health of their baby. Being a poor HIV/AIDS-positive breastfeeding mother without Botswanan citizenship is even worse, due to restricted access to



antiretroviral therapy, baby formula and healthcare in general. These findings are in line with those of Rascher et al. (2009), who in their exploration of the intricate links between HIV/AIDS and water stressed the importance of access to sufficient clean water for people living with HIV/AIDS and households caring for immuno-compromised individuals. In a recent policy shift, the government of Botswana will soon launch a government directive expanding free antiretroviral therapy to include foreign residents (UNAIDS, 2019). It will be interesting to follow this directive's impacts on the vulnerability and adaptive capacity of HIV/AIDS-positive non-nationals in relation to water shortage.

The findings point to nationality as an important underlying factor: non-nationals of lower socio-economic status are generally discriminated against in hiring policies and healthcare. They are thus more often found in subsistence, informal, or water-intensive livelihoods, which are particularly vulnerable to water shortage. But this study does not point to ethnicity as an important factor, even though it is considered fundamental in an individual's relationship to power in most contexts (Kaijser & Kronsell, 2014; Osborne, 2013). The narratives of the national participants belonging to different ethnic groups represented in this study – primarily Tswana and Kalanga – do not show any differences in terms of vulnerability and adaptive capacity. However, this does not mean that asymmetrical power structures pertaining to ethnicity are not present in Botswana. Studies in fact indicate the opposite (Werbner, 2002; Wilmsen & Vossen, 1990). That ethnicity does not seem to influence vulnerability and adaptive capacity in this study can perhaps be explained by most participants coming from the dominant ethnic group and from an elite minority group with relative educational and entrepreneurial success (Werbner, 2002), coupled with an underrepresentation of smaller ethnic groups. Further research will be needed to fully establish the role of ethnicity in household vulnerability and adaptive capacity to water shortage in Gaborone.

Age does influence adaptive capacity, when intersecting with middle and lower socio-economic status. First, it can be challenging for young women and men from these socio-economic circumstances to engage in risk-reducing measures, as they have limited savings, limited income opportunities – because of high youth unemployment and being a student – as well as limited access to assets, e.g. land ownership and housing tenure. Their situation is very similar to that of non-nationals. Second, elderly women and men from lower socio-economic status no longer engaged in the formal employment sector – due to either retirement or illness – are often solely dependent on subsistence agriculture, which is impacted by drought and the water shortage.

In summary, our data suggest that using an intersectional lens can facilitate a deeper understanding of water shortage in different ways. While the data cannot support broader generalizations, it is fair to assume that some of the intersecting factors in vulnerability and adaptive capacity among our participants would be applicable in similar settings. And the intersectional approach underpinning this research would also be valuable in other contexts, such as Cape Town for example, even if the intersecting underlying factors differ. First, it could assist in the analysis to identify vulnerable households. Second, it could help uncover why households engage (or not) in certain coping and adaptation activities, based on adaptive capacity determined by the interaction of various underlying factors. Lastly, it enables a deeper multidimensional understanding of why these patterns of vulnerability and adaptive capacity exist – revealing systems of power that create differentiated opportunity and constraint that either enable or disable individual agency *vis-à-vis* water shortage.

## Conclusion

Water shortage is not experienced uniformly, and our participants did not express a uniform understanding of adaptation to it. Instead, it seems to have been informed by the current means of coping and adaptation within a hierarchical order, further influenced by their socio-economic background. Water shortage has numerous effects, including disruption of daily life in terms of changing household chores and time spent on accessing water, changing routines, altered water use and water source, disruption of livelihoods for subsistence households and people with water-intensive jobs, health challenges due to poor water quality and the disruption of established healthcare routines, and social exclusion and embarrassment. The participants are thus actively employing various strategies to reduce the risk of water shortage, but these are mostly coping rather than adaptive in nature.

Power structures, both within individual households and in society at large, can contribute either positively or negatively to individuals' experiences with and vulnerability to water shortage. It is not only the less affluent households that are vulnerable to water shortage; more affluent households also struggle with issues of health, social exclusion, and asymmetrical intra-household and community power relations, which disproportionately affect women more than men. We therefore suggest moving beyond the conventional emphasis on access to financial resources and poverty as the primary determining factor for impact, and also considering the fundamental contribution of, for instance, gender and nationality to vulnerability and adaptive capacity, especially given that there are lucid examples of adaptive strategies in some poorer households, with minimal financial means, that reduce their vulnerability to water shortage.

With intersectionality as a heuristic device it becomes clear that the properties of vulnerability and adaptive capacity are not uniformly distributed either between or within conventional social categories. Hence, the effects of water shortage are significantly determined by the interaction of several underlying factors, such as the identity markers pertaining to gender, age, nationality, and socio-economic structures, in conjunction with the contextual factors of health, care-giving, employment status and land and housing tenure. At their intersection, each individual is subject to compound power structures that can either enable or constrain her adaptive capacity. The intersectional perspective thus facilitates overcoming a gap in contemporary theory of vulnerability and adaptation to water shortage that often focuses on a single dimension of the phenomenon. Thus, we argue for a better understanding of the intricacies of water shortage, and other disruptive or disastrous events, by looking at the interrelated and interdependent aspects of effects, coping and adaptation strategies, as well as the underlying societal power structures influencing these.

## Notes

1. Batswana is the official word used to describe citizens of Botswana in plural form.

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No potential conflict of interest was reported by the authors.

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