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Drought response impacts on household water use practices in Cape Town, South Africa

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Abstract

Cape Town recently endured a record-breaking drought which nearly ended in disaster for the city's water supply. Municipal authorities introduced several measures to curb water demand using both monetary and other incentives, but little is known about how effective these measures were at encouraging people to save water. Previous literature shows no consensus as to which types of measures are most effective for managing residential water demand. Using information obtained through semi-structured, in-depth interviews with 20 individuals living in houses where they paid their water bills, this study provides insights on how respondents interpreted and responded to these mechanisms. Results show that price mechanisms were considered to be ineffective and did not encourage people to save water in their households. Non-price mechanisms were seen as having more impact on respondents, encouraging water conservation behaviour; especially when it comes to household indoor water use activities related to hygiene. While previous studies primarily provide quantitative data to measure the effectiveness of water demand management strategies, this paper adds a qualitative understanding of how and why households' water use practices change in response to these measures.

Keywords: Behaviour change; Cape Town drought; Day Zero; Water demand management; Water restrictions; Water tariffs

1. Introduction

Cities around the world increasingly face water crises due to droughts, increased water demand for consumption, climate change, political intransigence, and lack of the maintenance of infrastructure

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for water supply, alongside growing urban populations (Swyngedouw *et al*., 2002; Bakker, 2013a, 2013b; Enqvist & Ziervogel, 2019). Many urban areas are simultaneously reaching the limits to how much water they can draw from rural hinterlands (McDonald *et al*., 2011, 2014). This requires city governments to think carefully about how to encourage more efficient and sustainable consumption of existing water resources among residents, companies, institutions, industries, and others. Many cities have prioritised water demand management (WDM) strategies, which include price mechanisms (water tariffs) and non-price mechanisms (often including water restrictions and awareness-raising campaigns) (Kanakoudis, 2002; Willis *et al*., 2011; Hughes *et al*., 2013; Stavenhagen *et al*., 2018). In Cape Town, domestic consumption in households uses the largest share (70%) of the city's water supply (Enqvist & Ziervogel, 2019), making actions to curb household water demand essential.

There is no clear consensus in the literature as to which mechanisms are most effective for the management of residential water demand. For instance, Olmstead & Stavis (2009) argue that adjusting the price of water is a cost-effective way of driving down consumption to reach water conservation goals. However, others point out that price mechanisms have limited effect since most water uses cannot easily be substituted and the money spent on water is a relatively small part of a typical household budget (Gaudin *et al*., 2001; Garcia & Reynaud, 2004; Reynaud, 2013). There is increasing support for non-price mechanisms that influence water use through restrictions and awareness raising. These are often implemented together with price mechanisms, but it is important to understand how each of them affects water consumption behaviour (Syme *et al*., 2000; Araral & Wang, 2013).

In 2017 and 2018, the metropolitan municipality of the City of Cape Town (CoCT), South Africa, ramped up its price and non-price mechanisms (hereafter referred to as CoCT's actions) to encourage people to save water in response to the drought that had started in 2015 (CoCT, 2018; Ziervogel, 2019). These measures included: water restrictions and increasing water tariffs; installing water management devices that restrict the flow of water and so limit household consumption to below a set level; and establishing a water conservation campaign which included information about the threat of 'Day Zero' (when domestic taps would be completely turned off unless consumption was reduced) (CoCT, 2018; Joubert & Ziervogel, 2019; Ziervogel, 2019). The efficacy of CoCT's WDM actions has been explored by Visser and colleagues by using smart meter data on household-level water consumption (Brick & Visser, 2017; Booysen *et al*., 2019). These studies show that behaviour *can* be changed and provide a sense of how it has changed. Since their research draws on quantitative data, it does not say much about why changes occur.

This study focuses on exploring the meanings and interpretations that households attributed to CoCT's actions, in order to understand how these actions impacted water use practices. From the range of actions implemented by CoCT, the study focuses on water restrictions, water tariffs, and the Day Zero communication campaign. This is because, unlike some actions, these three were applicable to every household in Cape Town, except for indigent households who get a free allocation of municipal water. Interventions like water management devices that were installed to cap consumption to a certain limit only targeted some households rather than everyone in the city. The paper begins with a brief overview of price and non-price mechanisms to influence water consumption, followed by a description of CoCT's responses to the drought. While previous research has primarily focused on quantitative data to measure the effectiveness of these strategies, this study uses a qualitative approach to explain how and why households' water use practices change in response to these measures. It concludes with a discussion on the impact of different CoCT actions on respondents, especially when it comes to household indoor water use activities related to hygiene.

1.1. Price and non-price mechanisms

The debate around price and non-price mechanisms for WDM is largely documented in the economic literature. Araral & Wang (2013) claim that price mechanisms are the most common water conservation measures for urban WDM. These strategies, according to Asci *et al.* (2015), give households the freedom to decide the nature of changes in water use practices in response to the increase in prices. In this regard, households can be aware of how much water they use through their water bills and decide to adjust to low-cost water use practices in order to minimise their private costs associated with water consumption (Asci *et al.*, 2015). For example, there is a view that adjusting the price of water, so that it reflects the true cost of producing it, is an effective tool to manage demand for water because consumers are assumed to adjust consumption practices according to price changes (Herbertson & Tate, 2001; Olmstead & Stavis, 2009; Araral & Wang, 2013; Asci *et al.*, 2015; Kanakoudis & Gonelas, 2015a; Gonelas & Kanakoudis, 2016; Stavenhagen *et al.*, 2018). However, there are debates regarding their efficacy in terms of bringing about change towards more sustainable water consumption practices (Asci *et al.*, 2015).

The efficacy of price mechanisms mostly depends on how elastic water demand is to price, which refers to how much effect changes in price have on people's water use practices (Tsai *et al.*, 2011; Asci *et al.*, 2015; Stavenhagen *et al.*, 2018). High elasticity means that practices can change a great deal in response to changes in price. The ability to reduce water use is highly dependent on factors such as seasonal weather conditions or household characteristics, to mention a few (Asci *et al.*, 2015).

A substantial amount of work and research on WDM has focused on price mechanisms with less focus on non-price mechanisms. It is only recently that WDM strategies are increasingly paying attention to non-price mechanisms (Tortajada *et al.*, 2019). This is partly due to empirical research showing that domestic water consumption is influenced by socio-demographic factors (household size, gender, education level, and attitudinal variables), environmental variables (temperature and precipitation), and household economic variables (income and available technology, i.e. water-saving plumbing fixtures) (Hanke & de Mare, 1982; Vickers & Markus, 1992; Jorgensen *et al.*, 2009; Kanakoudis & Gonelas, 2014, 2015b; Shan *et al.*, 2015). Several water utilities are, in fact, making efforts to incorporate behavioural nudges in their WDM strategies (Brick & Visser, 2017; Brick *et al.*, 2017; Tortajada *et al.*, 2019). The nature of messages delivered by utilities and policymakers for encouraging households to adopt water conservation practices is, therefore, also important (Tortajada *et al.*, 2019). This is because establishing consistent messaging around water crises and other issues relating to WDM can contribute to a sound water conservation culture (Fielding *et al.*, 2012).

Non-price mechanisms place a direct control over water use through rationing or relying on changing people's habits and water use practices rather than affecting the price of water (Reynaud, 2013). They include water restrictions, prohibition of certain water uses, community mobilisation, education- and awareness-raising campaigns, as well as making use of technical and engineering mechanisms such as leak detection instruments, constant-flow meters, and pressure-reducing valves (Kenney *et al.*, 2008; Araral & Wang, 2013; Reynaud, 2013; Kanakoudis & Gonelas, 2015a, 2015b).

Some authors have looked at direct comparisons between these two types of mechanism in terms of their effectiveness to result in reduced residential water consumption and found varied impacts (Martínez-Espiñeira & Nauges, 2004; Kenney *et al.*, 2008), while some concluded that price mechanisms are more cost-effective tools than non-price mechanisms for WDM (Olmstead & Stavis, 2009). However, Reynaud (2013) argues that comparing the effectiveness of price and non-price mechanisms

for residential water consumption is difficult to undertake because of two main reasons. First, it is difficult to evaluate their effectiveness individually as the two usually interact in fostering water conservation (Syme *et al*., 2000; Reynaud, 2013). Second, education- and awareness-raising campaigns have the potential to serve as motivation for people to respond to price mechanisms but if such motivation is not properly understood, it is likely that changes in residential water use will always be incorrectly attributed to price mechanisms (Reynaud, 2013).

Taking the above into consideration, the lack of clear consensus regarding the suitability of these mechanisms to curb water demand extends to their efficacies. Some authors argue that these are most effective when they are implemented together to support each other in managing residential water demand (e.g. Kenney *et al*., 2008), while others such as Syme *et al*., (2000) and Reynaud (2013) note the difficulty of evaluating the effectiveness of these mechanisms when they are implemented together because their impacts could easily overlap. Moreover, most of these studies are based on pre-existing quantitative data that have been used to model changes in water consumption to measure the impact and effectiveness of water conservation mechanisms. None of the studies mentioned have engaged with the nature of changes in residential water use and motivations behind maintaining certain household responses to these mechanisms. Therefore, qualitative studies of this nature are important because they help understand nuance and apparent contradictions in more quantitative data and can help answer the 'why?' behind other findings.

2. CoCT's actions for managing the water crisis

Cape Town, situated in the Western Cape Province of South Africa, has experienced the driest 3-year period (from 2015 to 2017) in the catchment area since rainfall measurements started in the 1930s. Such periods are estimated to occur once in about every three hundred years (Wolski, 2018). However, research indicates that water crises are becoming more likely to occur due to climate change, increasing population, changing political landscapes and increases in consumption demand (Swyngedouw *et al*., 2002; Bakker, 2013a, 2013b; Otto *et al*., 2018; Enqvist & Ziervogel, 2019). When the water crisis started in the Western Cape in 2015, extending to 2017 and 2018, it placed enormous pressure on the CoCT's water supply. The water supply for the region is fed by six dams in the catchment and supplies a large agricultural area and a number of municipalities, of which the Cape Town metropolitan area, with approximately four million Cape Town inhabitants, is one (Sorensen, 2017; Booysen *et al*., 2019; Enqvist & Ziervogel, 2019; Joubert & Ziervogel, 2019).

In response to the intensification of the drought, CoCT gradually undertook several actions to reduce water use. This included several different levels for water restrictions, with the highest being Level 6 and Level 6B (in February 2018), increased water tariffs, and a communication campaign around the threat of Day Zero from October 2017 to March 2018 to encourage behaviour change (Joubert & Ziervogel, 2019) (Table 1). Central to the restrictions was the prohibition of certain water use practices such as gardening, outdoor pools, and washing cars with municipal tap water. Level 6B water tariff came into effect with the aim of charging more for the use of high volumes of water. A communication campaign took place through radio, print, and social media, essentially reaching out to citizens and mobilising for the reduction in the city's water consumption, as well as encouraging people to use less water and stay below the water restrictions (CoCT, 2018). Central to this campaign was the possibility of the occurrence of Day Zero. After the growing threat of Day Zero being a few months away in

Table 1. Timeline of CoCT's responses to the water crisis in Cape Town (GreenCape, 2018; Booysen *et al*., 2019).

Date	CoCT's responses to the water crisis
2016	
01 January 2016	Level 2 water restrictions
01 November 2016	Level 3 water restrictions
2017	
01 February 2017	Level 3B water restrictions (target of 800 MLD for the city)
22 May 2017	Western Cape declared a disaster area
01 June 2017	Level 4 water restrictions (100 L/person/day)
01 July 2017	Level 4B water restrictions (87 L/person/day)
30 July 2017	Day Zero used to refer to Cape Town water crisis (by Western Cape Premier Helen Zille)
17 August 2017	Water resilience plan released
03 September 2017	Level 5 water restrictions (87 L/person/day)
04 October 2017	Critical water shortages disaster plan released
October 2017	The concept of Day Zero officially adopted by the CoCT
2018	
01 January 2018	Level 6 water restrictions (87 L/person/day)
12 January 2018	Day Zero estimated to be 22 April 2018
18 January 2018	Mayor's announcement that Day Zero was likely to occur
19 January 2018	Day Zero estimated to be 21 April 2018
26 January 2018	Day Zero estimate to be 12 April 2018
01 February 2018	Level 6B water restrictions (50 L/person/day) (punitive water tariffs for water users using above 10.5 kL of water)
02 February 2018	Day Zero estimated to be 16 April 2018
05 February 2018	Day Zero estimated to be 11 May 2018
16 February 2018	Day Zero estimated to be 04 June 2018
23 February 2018	Day Zero estimated to be 09 July 2018
02 March 2018	Day Zero estimated to be 15 July 2018
07 March 2018	Day Zero *cancelled* for 2018
21 July 2018	New tariffs for 2018/2019, which include a fixed as well as a consumptive charge

MLD, million litres per day; kL, kilolitres.

early 2018, its arrival was gradually postponed and eventually 'cancelled' in March as CoCT announced that this was unlikely to occur in 2018 (GreenCape, 2018; Joubert & Ziervogel, 2019; Ziervogel, 2019).

Booysen *et al*. (2019) show that social media coverage of the drought and the release of the CoCT's Critical Water Shortages Disaster Plan in October 2017 resulted in more changes in behaviour than the introduction of Level 5 water restrictions. However, due to contradictions in communication from national and provincial government, some of these changes were eroded (Booysen *et al*., 2019). There was also some confusion with Level 5 restrictions because they came with two conflicting requirements; one part was similar to Level 4B restrictions (87 L/person/day with the implication that a household of four people would use 10.5 kL/month) (GreenCape, 2018) and the other part capped residential properties at 20 kL/month (Booysen *et al*., 2019). Booysen *et al*. (2019) speculate that maybe CoCT put forward the 20 kL/month to be more lenient on, or accommodate, low-income properties that have larger household sizes. This was, however, not clearly communicated or explained, thus sent a mixed message to most households with average size (3.50 persons according to the city's 2011 census) (CoCT, 2011), who were already using 10.5 kL/month or less (Booysen *et al*., 2019).

Presently, little is still known about the impact and effectiveness of CoCT's actions and how they have landed in practice in terms of residential water demand, especially during the final stages of the crisis in 2018 (Booysen *et al.*, 2019). There is a need to document how the public understands, interprets, and incorporates these mechanisms into their own household water use practices and build knowledge about which of these interventions encourages people to save water most. This is relevant both for policymaking in Cape Town and cities facing similar challenges, and in order to inform research around the impact and effectiveness of price and non-price mechanisms.

3. Methodology

The study used in-depth face-to-face interviews to explore how CoCT's different drought responses impacted on household water use practices. The target was a non-representative sample of 20 households in Cape Town. The reason for choosing this sample size is because this research was not focusing on the spread of opinions and views across a large population which would require a representative sample but sought to conduct in-depth interviews to gain insight about people's experiences, interpretations, and meanings of CoCT's actions for water conservation and how they influenced water use practices.

3.1. Data collection

Purposive sampling was used to select groups or categories of the sample to be included in the study. Purposive sampling refers to non-random ways (such as stratified sampling and snowball sampling) that are used to ensure that particular groups or categories of the sample are present, based on the aim and objectives of the study (Robinson, 2014). The focus was on low-income (but not indigent households that get municipal water from CoCT without having to pay for it) and middle- to high-income households. The target was individuals who are responsible for paying the water bill, who reside in a free-standing house, have lived at the current address from at least the beginning of 2017 up until the time of the interview, and who are not and do not have family members that are employees of CoCT (Willis *et al.*, 2013). The respondents were contacted through social networks and some through referrals from other respondents.

The interviews were conducted in November and December 2018, during which water restrictions were eased down from Level 6B to Level 5 in November, and then to Level 3 in December. Households in eight different Cape Town residential areas were identified, including Crossroads, Delft, Dunoon, Joe Slovo Park, Khayelitsha, Kuils River, Observatory, and Philippi (Figure 1). These households were included in the study based on their interest to take part in the interviews. These areas are characterised by different socio-economic contexts (Table 2), with Crossroads, Dunoon, and Philippi classified in the 2011 Census as low-income areas (average household income: R1–19,200), while the rest of the areas fall into the middle-income category (R19,201–R307,200) (StatsSA, 2015). However, as Table 2 shows, the average income of households in Delft, Joe Slovo Park and Khayelitsha is significantly lower than Observatory and Kuils River.

The interviews consisted of open-ended questions. The first section of the interview focused on demographic information and household characteristics (Table 3), collected in order to understand some of the factors that may influence water consumption and respondents' engagement with CoCT's actions. This information was necessary to record because the number of household members

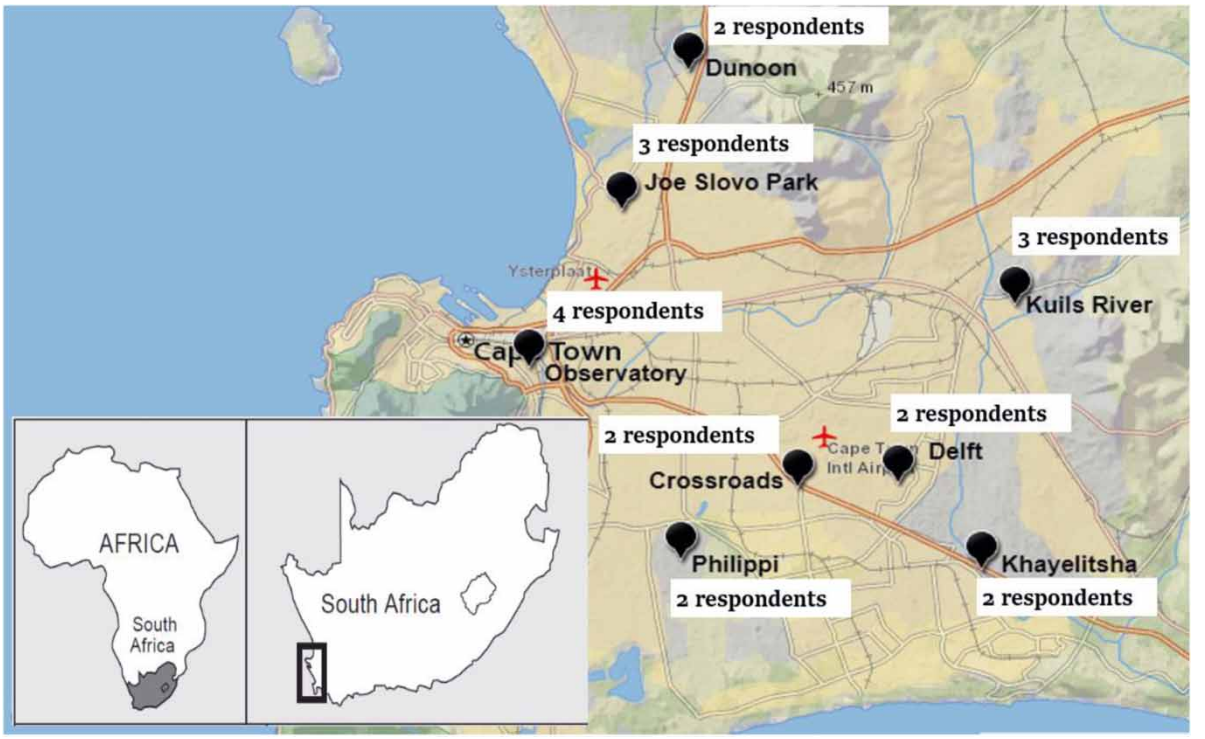

Fig. 1. Location of residential areas (shown by the pins) where interviews were conducted.

Table 2. Socio-economic context of the studied residential areas (The Census 2011 provides statistics for administrative divisions or wards and not per residential area. Average annual household income is based on median estimates) (StatsSA, 2011)

Suburb	Administrative division	Average annual household income	% of those who completed grade 12 or higher	% of the population employed
Crossroads	36	R14,600	27.1	31.6
Delft	13	R29,400	24.1	39.7
Dunoon	104	R14,600	27	48.4
Joe Slovo Park	4	R57,300	60.9	64.8
Khayelitsha	92	R57,300	55.9	45.4
Kuils River	11	R230,700	62.8	61.2
Observatory	57	R115,100	61.4	45.1
Philippi	80	R14,600	30.5	40.6

is likely to impact on how much water is used in the household. The remainder of the interview looked at: (i) respondents' understanding of the timeline and nature of the actions taken by CoCT to encourage people to save water, (ii) the meanings and interpretations attached to, and the effectiveness of, CoCT's actions for household water users, (iii) the nature of, and motivations behind, household responses (in terms of how they use water) to CoCT's actions and (iv) drivers and motivations for maintaining and/or

Table 3. Household information relevant for the study ('JoJo Tank' refers to containers for collecting and storing rainwater).

Suburb	Number of household members	Own/rent the house	TV and/or radio	Alternative water source	Monthly payment for water
Crossroads	5	Own	Both	No	+/− R200
	3	Own	Both	No	+/− R2,000
Delft	6	Own	Both	No	Do not pay
	3	Own	Both	No	Maximum R900
Dunoon	3	Rent	None	No	Do not pay
	6	Own	Both	No	Do not remember
Joe Slovo Park	5	Rent	Both	No	Do not pay
	7	Own	Both	No	Do not pay
	4	Rent	Both	No	Do not pay
Khayelitsha	4	Own	Both	No	Maximum R2,000
	3	Rent	Television	No	Do not pay
Kuils River	6	Own	Both	No	+/− R3,000
	4	Own	Both	No	+/− R1,000
	4	Own	Both	No	+/− R500
Observatory	1	Own	Both	JoJo Tank	Do not remember
	2–4	Own	Both	No	R150–R180
	3	Own	Both	No	Do not remember
	2	Own	Both	JoJo Tank	R140–R150
Philippi East	2	Own	Both	No	R2,000
	3	Own	Both	No	R1,000

Some were not paying their water bills even though required to pay.

discontinuing the new behaviour in terms of certain household water use practices in response to these actions.

3.2. Data analysis

The interviews were audio recorded and transcribed. Quotes are referenced by an anonymous respondent ID number and the area that person lives in, e.g. 'Respondent 1, Kuils River'. The first part of the analysis involved the use of NVivo software for coding, to identify patterns or themes from the data. This step was inductive, looking at the data and identifying common themes that emerged. Similarities and differences between the codes were then identified and those that connected were combined. The transcripts were coded for residents' awareness of CoCT's actions, understanding of the actions mentioned, importance of CoCT's actions, household responses to CoCT's actions, and drivers and motivations for maintaining and/or discontinuing the newly adopted water use practices.

4. Results

4.1. CoCT's actions and respondents' interpretation

The results show that respondents obtained information about CoCT's actions to curb water use from a range of different sources. They viewed social media as the most important source to make people

aware of the Day Zero communication campaign and water restrictions, while posters played an important role for informing them about water tariffs (Figure 2).

Respondents highlighted that messages around water restrictions included telling people to reduce water use, or to use water within the limits determined by CoCT and the banning of some water use activities that were not seen as essential, such as car washing and watering gardens. Some respondents indicated that they were frustrated because CoCT did not provide sufficient and clear information about restrictions, they felt that the restrictions required households to reduce water too much and the municipality took a long time to respond to the water crisis. Others noted that they were fine with water restrictions being ramped up, stating that the drought had put Cape Town in a very bad situation as far as the availability of water is concerned.

> *'I think the level 6B water restrictions were fine because to be quite honest the drought was bad in Cape Town. Taking everything that was said in the news and the media, it looked like Day Zero was going to happen.'* (Respondent 1, Joe Slovo Park)

The messages that people received around water tariffs were mainly around an increase in how much households needed to pay for water. This included charging a higher rate to those whose water use went beyond the limit set by water restrictions, and an increase in water bills. These messages left different impressions in terms of how people interpreted the communication about an increase in water tariffs. While most respondents expressed their disapproval of the way in which this increase was done, a few stated that they were fine with how things were handled as far as the increase of water tariffs goes. Those who presented their disapproval cited reasons such as being angry that CoCT increased

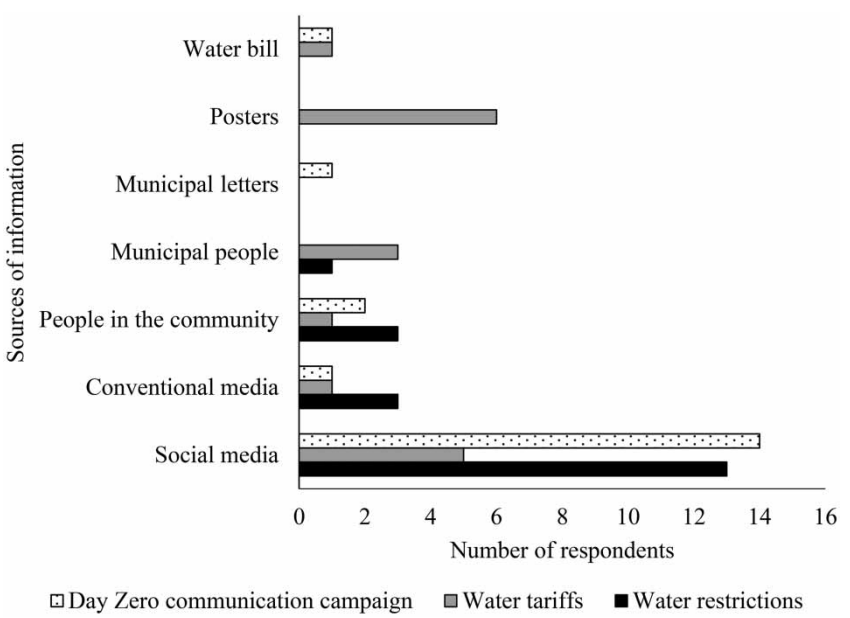

Fig. 2. Most important sources of information that made people aware of CoCT actions (respondents were allowed to mention more than one source).

water tariffs because even though they tried to save water, the money they were charged was still considerable, so they felt it did not reflect the cost of the actual water use. They also stated that tariffs were unfair because they did not target high water users enough, and because those who could afford to pay for water could still use water as they wish as long as they settled their water bill. On the other hand, some respondents were happy with the increase in water tariffs and the messages around such increase as they felt that this forced many people to re-evaluate the way they use water. One respondent felt that it was the right thing to do because the CoCT had to find ways to fund the cost of providing water, despite it being unfair to a certain extent because it did not target high water users enough.

With the Day Zero communication campaign, the majority of respondents indicated that the main message was that Cape Town was going to run out of water and taps were soon to become completely dry, without having any water coming out of them. This did not leave a positive impression on people; most respondents indicated that they were scared and frustrated by these prospects. One of these respondents was annoyed and viewed the Day Zero communication campaign as a 'scare tactic' used by the government to instil fear on people, forcing them to pay attention to the water crisis. This respondent acknowledged that there was a water shortage but did not agree with this campaign because of the public fear it resulted in. One respondent, however, stated that Day Zero was communicated in a way that encouraged people to work together in finding ways to save water during the water crisis.

The above set of responses regarding how respondents interpreted the three CoCT's actions was common across the different socio-economic areas. The frustration concerning water restrictions and disapproval of the increase in water tariffs, as well as the fear that the Day Zero communication campaign resulted in, came up in both low-income and middle-income households during the interviews. This was also the case for the respondents who expressed that they were fine with how things were done regarding the three actions.

Respondents were also asked to share personal stories or anecdotes about the impact of the crisis. These narratives document a range of different experiences of what the drought meant for people:

> *'Most people in our community are involved in gardening, especially planting vegetables. They plant vegetables and sell them around to get money to provide for their families. When the restrictions increased people did not have enough water in the taps to water their vegetables. As a result, some vegetables died. Even here at home we suffered from that. When this happened, some people did not have vegetables to sell anymore. It was really bad. Our neighbour's flowers also died because they could not get enough water from the taps to take care of them.'* (Respondent 1, Delft)

> *'When the news about Day Zero started to spread all over, people started collecting as much water as possible from the public taps outside using the 5 Litre water bottles. We collected those and stored them for just in case Day Zero happens. This caused some tension between some people because if you have many water bottles to collect the water some people complained about that.'* (Respondent 1, Delft)

> '*Some people said they had received letters threatening them that their taps would be completely turned off if they do not pay the required amount of money immediately. That is really bad, when you cut off the water, where do you expect people to go? One lady called me panicking, saying that she has a problem. I was really scared, thinking maybe her husband passed away since he was ill around that time. She was calling to ask for money because the water was going to be*

turned off if she does not pay the money. I even drove to her place because she was really panicking.' (Respondent 1, Kuils River)

As these examples show, the water crisis threatened people's livelihoods, created tensions in communities, and distressing rumours and uncertainty regarding potential loss of access to water. This demonstrates the range of pressures created in a population beyond the most immediate challenge to conserve water.

4.2. What CoCT actions did respondents see as most effective?

Interviews revealed that most respondents consider increased water restrictions to be the most effective way to encourage people to save water (Figure 3). For this, respondents stated that limiting water use to a certain numbers of litres, which was the main message around water restrictions, helped in providing information about how much water households should use during the water crisis. Households, therefore, incorporated such information into their water use practices.

Of the three CoCT actions studied here, respondents viewed the Day Zero communication campaign as most effective for raising awareness about the water crisis (Figure 3). Some indicated that the fear of running out of water made them feel concerned about the crisis. Others saw this campaign as an action that brought about necessary and useful information about the water crisis, thereby creating awareness. This gave them an opportunity to learn about the nature of the crisis and ways in which people could help manage it by saving water in their households.

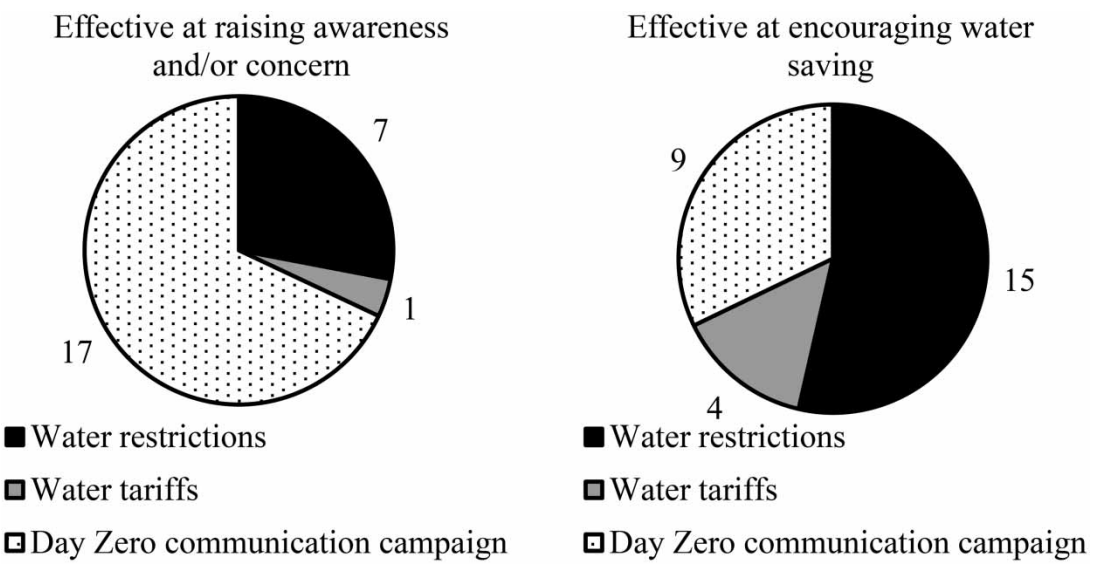

Fig. 3. For raising awareness and concern about the drought, most viewed the Day Zero communication campaign as most effective. Most respondents saw water restrictions as most effective for encouraging them to save water.

4.3. Changes in household water use practices in response to CoCT's actions

Most respondents stated that they have changed the way they use water around their households. The majority (12/20) mentioned toilet flushing as using the most water in their households before the crisis. The most common change introduced (by 14/20 respondents) was using greywater for flushing. This was mentioned by the three respondents from low-income households and 11 respondents in the middle-income category.

'We have two buckets in the bathroom that we use to collect water while showering and use that water to flush the toilet.' (Respondent 2, Kuils River)

Because of the changes made in households, at the time of the interviews flushing was no longer seen as using the most water. This was except for one respondent who still considered flushing to use most water in their household because they had not established ways to change from using municipal water for it.

After flushing, bathing (11/20) and showering (9/20) were seen as using the most water before the crisis. Here, 8 of 20 respondents reported having limited these activities in their households. This was mainly based on taking short showers and using a small amount of water when bathing. Respondents indicated that the changes made in their water use practices were mainly prompted by an increase in water restrictions and the Day Zero communication campaign, and less so by increased water tariffs.

4.4. Drivers and motivations for maintaining and/or discontinuing the new behaviour

While almost all the respondents indicated that they have been able to maintain the changes they made and continue with their new behaviour, one mentioned that they have changed back to using water as they did before CoCT enforced its actions to curb water demand. This respondent cited the discontinuation of the Day Zero communication campaign as the reason for changing back.

'We changed back when we heard that Day Zero was not going to happen. We flush the toilet and use the bath now.' (Respondent 1, Khayelitsha)

For those who maintained the changes in water use practices, motivations included trying to avoid water cut-off city-wide in a future Day Zero scenario by staying within the water restrictions and trying to make a difference as good and responsible citizens. For some, the Day Zero communication campaign was a great initiative in terms of sharing information necessary to motivate people and encourage positive action. Moreover, six respondents stated that their motivations came from understanding how serious the drought was, which made them pay attention to it and think of ways to use less water around their households.

'We are conscious of the fact that the drought is a very serious issue, not in Cape Town only but also some parts of the world. Learning about it and having knowledge of how serious it is, encouraged us to maintain the changes.' (Respondent 4, Observatory)

5. Discussion

The results from this study suggest that most respondents perceive non-price mechanisms as being considerably more effective than price mechanisms. The Day Zero communication campaign was ranked highest in terms of raising awareness, and the water restrictions were ranked most important for encouraging water-saving behaviour at the household level. For most respondents, the main concern with water tariffs is that high water users can still use more water in their households if they can afford to settle the water bill at the end of the month. Some of the previous studies, even though largely quantitative, have also found that water tariffs do not have substantial impacts on residential water consumption (Magnusson, 2004; Jansen & Schulz, 2006; Tortajada *et al*., 2019). This points to a need for the better documentation of how and why households change their water use practices in response to changes in water tariffs. In fact, some studies have shown that water tariffs are particularly ineffective on high-income households (Magnusson, 2004; Moglia *et al*., 2018). Looking at WDM strategies in Spain, Tortajada *et al*. (2019) argue that for price mechanisms to work effectively, especially in the context of water users who are high-income earners, water consumption would need to be extraordinarily high for the price of water to have a significant impact on the household income. In the Cape Town context, even though most respondents seemed to believe that high-income earners could still use more water because they can afford to, the drought created an exception. The CoCT forced those using over 20 kL/month to reduce consumption by installing water management devices limiting their use to 10.5 kL/month. Over time, devices were rolled out to households using less than 20 kL/month too, but the strategy around who was targeted was not clear (Booysen *et al*., 2019). Considering the results from the Cape Town context and some of the previous studies, it is clear that water tariffs do not seem to have a significant impact on household water consumption.

The lack of motivation to respond to the increase in water tariffs may be because people do not trust that the money they pay reflects the amount of water they have used, as some respondents indicated that even though they saved water their water bill was still high. Issues involving trust, especially towards water meter readings and the water bill, have been noted in other studies. In Pietermaritzburg, South Africa, Smith & Green (2006) found that meter readings are one of the factors that have led to confusion and distrust towards the municipality. This is because people had difficulties understanding how the water meters work, did not trust the person responsible for reading the meter and had problems checking whether the amount of money they were paying for water was realistic and a true reflection of their usage (Smith & Green, 2006). Studying the effect of price and behavioural signals for encouraging water conservation in the UK, Lu *et al*. (2019) reported that households are sometimes put in vulnerable situations where the amount of money in the water bill is based on estimates rather than the actual meter readings. This then leads to confusion, especially when the water tariffs increase. Looking at these studies and findings in this paper, it seems that transparency and better communication should receive more attention when water utilities implement increases in water tariffs.

Respondents indicated that water restrictions played an effective role in encouraging households to save water during the crisis. They claimed that this was mainly because water restrictions provided clear information about how much water households were supposed to use per day. This aligns with findings from previous research in Iowa (Lee & Warren, 1981), Texas (Shaw & Maidment, 1988), Southern California (Shaw *et al*., 1992), Athens, Greece (Kanakoudis, 2002), and Colorado (Kenney *et al*., 2004). Although these studies provide useful empirical evidence on the effectiveness of water restrictions to curb water consumption, they do not explain how and why water use practices changed. This paper therefore

complements previous research to provide a deeper understanding of people's experiences regarding their engagement with water restrictions, including the changes they made in water use practices in response to these restrictions. The current study, using household-level qualitative data, helps to gain insights on how and why changes in water use practices occur when restrictions are in place.

In Brisbane and Melbourne, respondents reported that water restrictions played a significant role in encouraging households to change their consumption, shifting towards more sustainable water use practices (Lindsay & Supski, 2017). Quantifying the impact of an increase in water restrictions on water use by single-family residences across Los Angeles, Mini *et al.* (2014) found that mandatory restrictions resulted in 19–23% water use savings in the Spring and Summer periods. In summary, the current study supports previous claims that water restrictions are an effective measure to reduce water conservation at the household level. Furthermore, the findings indicate that compared with increased water tariffs, restrictions are a more effective measure to decrease water use.

The Day Zero communication campaign was the most effective action for raising awareness about the water crisis, according to the respondents. Education- and awareness-raising campaigns are acknowledged globally as being one of the most important non-price mechanisms for city governments to use (Martínez-Espiñeira & García-Valiñas, 2013; Dascher *et al*., 2014; Tortajada *et al*., 2019). These campaigns aim to play an important role in educating people about, encouraging and motivating them to pay attention to, situations such as water crises and possible ways to act in such crises. Tortajada *et al*. (2019) posit that an increase in public awareness campaigns is potentially the most important factor for explaining the conservation of water in households. Some of the respondents in the Cape Town context explained that the Day Zero campaign resulted in fear because people feared that the city would run out of water, and such fear made them feel concerned about the water crisis. Others claimed that this campaign gave people an opportunity to learn about and engage with the context of the crisis by providing them with necessary and useful information. Studying factors that determine the adoption of water conservation habits and water-saving technologies by households in Spain, Martínez-Espiñeira & García-Valiñas (2013) found that education and awareness campaigns resulted in a strong positive effect on households' decisions to adopt water conservation habits and buy water-saving technologies. Most recently, Tortajada *et al*. (2019) showed that education and awareness campaigns, which aimed at encouraging more efficient water use, as well as targeted campaigns for promoting the adoption of water-saving technologies in Spain, were most favoured by the participants, thereby yielding tangible results compared with other measures. Depending on how people interpret it, a campaign can be perceived as either a positive or negative action for encouraging water conservation. In the case of the Cape Town drought, the Day Zero communication campaign managed to raise awareness even though it was interpreted differently by the respondents, with some calling it a 'scare tactic', while others saw it as a way of educating people about the crisis.

Increased water restrictions and the Day Zero communication campaign led to changes in behaviour where households adopted more sustainable water use practices during the drought in Cape Town. A change in behaviour mostly occurred in household water use practices that previous studies have claimed to be difficult to change when water tariffs are introduced, such as those related to personal hygiene and food preparation (Arbués & Villanúa, 2006; Olmstead & Stavis, 2009). In most households, the primary driver of water use has been based on the desire to achieve cleanliness (Shove, 2003a). Water use practices such as showering, bathing, flushing and doing dishes and laundry constitute the reproduction of cleanliness within households. With these practices, people make means of maintaining societal standards of what is acceptable for cleanliness, even when the provision of a

resource (water) has been interrupted (Shove, 2003b), such as during water crises. The current study shows that with disruptions in water supply and CoCT's actions in place, particularly water restrictions and the Day Zero communication campaign, households were able to change their water use practices and learn new ways keeping clean. This is an important finding as it feeds into the debate around the (in)effectiveness of water tariffs and (in)elasticity of residential water demand to price (Araral & Wang, 2013; Reynaud, 2013; Stavenhagen *et al*., 2018). In the case of respondents in this study, water tariffs had no substantial impact on household water use.

The three actions studied here are only some of the factors that may influence household water demand during the Cape Town drought (CoCT, 2018; Ziervogel, 2019). Research on domestic water demand shows that consumption at the household level can also be influenced by factors such as settlement location, socio-economic and demographic variables such as household size and education level, and environmental variables such as temperature and precipitation (Jones & Morris, 1984; Jorgensen *et al*., 2009; Shan *et al*., 2015). Similarly, these factors can also affect people's perceptions of, and responses to, policy-level interventions. Although this study collected data from different socio-economic areas, it was not set up as an explicitly comparative study. Still, some observations were made that deserve comment. For instance, in both low- and middle-income households included in this study, using greywater for flushing was the most common change in water use practices, and respondents indicated that this was prompted by water restrictions and the Day Zero communication campaign. Similarly, the general concern about the crisis and the motivation to respond to it was mostly created by Day Zero and water restrictions in both socio-economic contexts. On the other hand, an increase in water tariffs seemed to have minimal to no impact on respondents, regardless of the different area contexts. Therefore, in this study, it seems that different socio-economic backgrounds did not show considerable differences in terms of how households responded to the WDM actions implemented by the CoCT. Moreover, these findings suggest that non-price mechanisms are better positioned than price mechanisms to encourage a behaviour change at the household level regardless of different socio-economic contexts.

6. Conclusions

This paper provides new insights on how and why non-price mechanisms are more effective than price mechanisms in encouraging people to save water around their households and creating awareness about water crises. In Cape Town, residents consider an increase in water restrictions and the Day Zero communication campaign more influential on water use than increased water tariffs. As such, cities need to focus more on understanding and using non-price mechanisms in WDM and water governance more broadly.

The Day Zero campaign was essential for raising awareness about the water crisis in Cape Town. It managed to keep respondents updated about the drought while also communicating possible ways to help deal with it. Awareness-raising campaigns play an important role in educating people about, encouraging and motivating them to pay attention to, the water crisis and possible ways to help manage it. However, targeted campaigns may not always have long-term impacts because some people tend to forget about them in the long run. When they are discontinued, people might go back to using water as they did before such campaigns were in place.

The study shows that respondents made different interpretations of CoCT's actions and this came to influence their responses to these actions. Day Zero was interpreted both as a scare tactic and an

educational campaign; water restrictions resulted in frustration for some while others accepted them; water tariffs were considered unfair among those struggling to cope with additional expenses. City governments therefore need to carefully consider how different measures might be interpreted by different members of the public, and what implications this might have for water use behaviour.

Given the debate in the economics literature on the effectiveness of WDM strategies, the findings in this study regarding the importance of non-price mechanisms are important and revealing especially in the context of a serious, city-wide resource crisis. Importantly, this study also indicates a difference in how different non-price mechanisms impact awareness and behaviour, respectively. Campaigns that raise concern for an impending threat like Day Zero might play an important role in 'priming' residents to accept behaviour change as demanded by resource use limitations like the water restrictions. Therefore, cities in South Africa as well as other drought-prone regions need to consider how to integrate non-price mechanisms more as water becomes increasingly important to manage sustainably and equitably.

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