



Sustainable water tariffs and inequality in post-drought Cape Town: exploring perceptions of fairness

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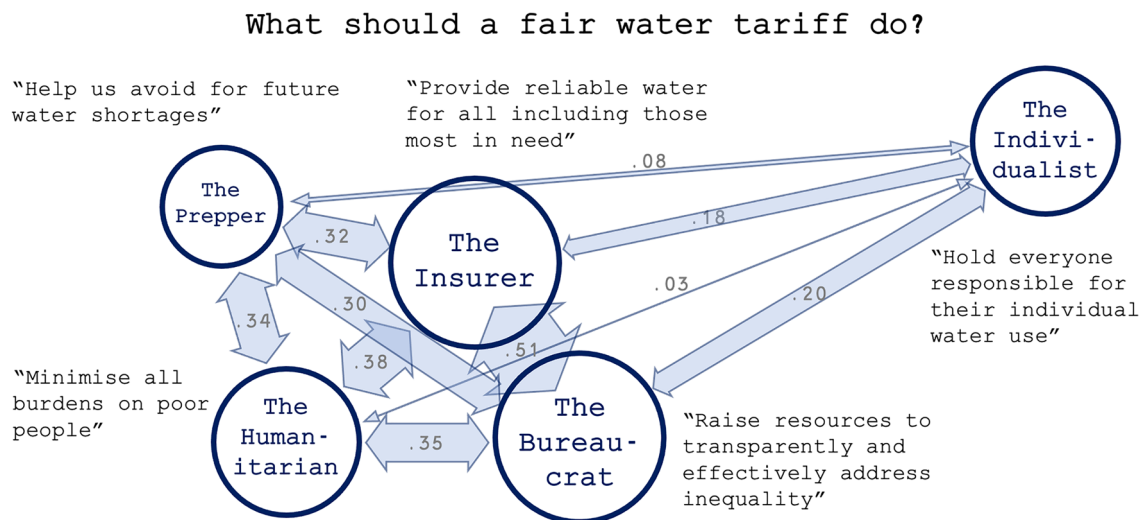
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Abstract

Fair allocation of diminishing natural resources is increasingly central to sustainability. This includes the allocation of costs related to providing access, such as dams, pipes and pumps delivering clean water. Water tariffs are often designed to both recover these costs, meet social needs of water services to the poor, and incentivise conservation in dry times. However, strained public finances, prolonged droughts and economic inequality can undermine these goals and force prioritisations that many see as unfair. This happened in Cape Town, South Africa, during its 2015–2018 water crisis. This study investigates what residents in three different socioeconomic contexts view as fair water tariffs 1 year after the crisis. Using Q method, we describe five distinct perspectives on fairness: ‘the Insurer’, ‘the Individualist’, ‘the Bureaucrat’, ‘the Humanitarian’, and ‘the Prepper’. These, we argue, can help distinguish between different ideas of what fairness implies, and what is required to promote it. We exemplify this by examining how viewpoints might have been shaped by specific communities’ experiences during and after the apartheid state’s discriminatory segregation policies. Using distributive, procedural and interactional interpretations of fairness, we discuss how the complex layers of poverty, inequality, mistrust, privilege and discrimination might produce different experiences and ideas of who should pay for and benefit from water services. Using these insights, we also reflect on the merits of tariffs that emphasise cost recovery and resource conservation over social needs, and the risks this poses for growing informal settlements in climate-stressed cities of the global South.

Graphical abstract

Using Q method, we identified five distinct perspectives with different views on what constitutes a fair water tariff.



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Keywords Block tariffs · Global South · Justice · Q method · Subjectivity · Water governance

Introduction

Fairness and justice are increasingly relevant to aspects of sustainability, as awareness of planetary boundaries requires decisions about how to allocate Earth's remaining 'safe operating space' (Leach et al. 2013; Steffen et al. 2015). Freshwater use, for instance, is not yet at an unsustainable level globally, but access is unevenly distributed and three in ten people still lack safely managed drinking water (UNICEF and WHO 2019). Climate change and urbanisation threaten to make water scarcity a reality for hundreds of millions more people by 2050—a threat particularly acute to residents in informal settlements of sub-Saharan Africa (Dos Santos et al. 2017; Flörke et al. 2018). In addition to environmental limitations to water supply, many countries also struggle to raise sufficient revenues for their water utilities (Dinar et al. 2015). Daily fiscal operations shape municipalities' ability to manage the flow of resources, but is an understudied dimension of urban resilience research (Simpson et al. 2019b). While some advocate for water tariffs guided by strict cost recovery principles, others point to the moral injustice and societal cost of making access to water contingent on people's ability to pay (Zetland and Gasson 2013; Barraqué and Montginoul 2015; Dinar et al. 2015). With water access increasingly defined by climatic unpredictability and urban informality, it is, therefore, critical to ask: how can sustainable water use be accomplished while also promoting justice and fairness?

This question has recently become urgently relevant in South Africa. In early 2018, the residents of Cape Town came less than 90 days away from having their water taps turned off (Enqvist and Ziervogel 2019; Parks et al. 2019). After 3 years of record-breaking drought, authorities were preparing for water rationing via public distribution points as a final effort to curb water use, if existing restrictions, raised tariffs, and public education campaigns were to prove inadequate (Department of Water and Sanitation 2018; Booyesen et al. 2019; Matikinca et al. 2020). While rationing was ultimately avoided, the water crisis was an existential shock to the city and its residents who remarkably lowered their water use by half (Brühl and Visser 2021). The experience brought attention to how new climatic threats could exacerbate dry spells, but in one of the world's most unequal societies it also renewed a realisation of the deep injustices around who has access to water services and how costs for them are allocated (Otto et al. 2018; Millington and Scheba 2020; Enqvist et al. 2020). In places where disparate living conditions make any intervention likely to impact people

differently and, therefore, generate different perceptions of its legitimacy and fairness, it is critical to understand people's subjective experiences. Subjectivity is increasingly acknowledged as an important dimension of sustainability dilemmas, but poorly understood by its scholars (Stedman 2016; Jones and Tanner 2017). In a water governance context, subjectivity is key for distinguishing between *fairness*, the perception that no one is given an improper advantage, and *equity*, which is to 'treat equals equally' in a more objective sense (Boland 1993).

In this study, we investigate subjective perceptions of fairness in Cape Town's water tariffs as the city recovered from the recent drought. The aim is to explore how justice can be better accounted for in situations with growing sustainability and inequality concerns. While such challenges are on the rise worldwide, the specifics of Cape Town require caution before making claims of universality. Current sentiments might predate the city's drought, and rather than measure its effect on perceptions of fairness our study should primarily be seen as an initial attempt to identify key factors in a complex web of local tensions and challenges. To this end, we first provide an overview of current and historical factors that contribute to injustice. We then complement this with a form of discourse analysis—Q method—developed to study topics where opinions are likely to vary and where understanding the breadth of perspectives has value in and of itself. Q method is particularly useful for engaging scientifically with subjective viewpoints (Brown 1980; Davies and Hodge 2007), and has proven useful in studying a range of social-ecological dilemmas, including environmental management of agricultural land (Davies and Hodge 2007), policies to promote water conservation (Iribarnegaray et al. 2014), urban biodiversity conservation (West et al. 2016), approaches to water recycling and reuse (Ormerod 2017), youth participation in farming (Sumberg et al. 2017), and citizen science in water resources management (Rutten et al. 2017). We employ this method to explore what subjective interpretations of fairness exist among different groups of Capetonians, and see how they differ and overlap, with particular attention to three interpretations of environmental justice: distributive (are outcomes fair?), procedural (is the process fair?) and interactional (are people treated fairly?) (Wutich et al. 2013; Mahlanza et al. 2016). These interpretations help capture the different levels at which injustice can be experienced, at a time when public acceptance and sense of legitimacy are emerging as increasingly critical components of water sustainability in Cape Town. While we acknowledge the potential philosophical value in a deeper

Fig. 1 Cape Town's geography is shaped by European colonisation (City Bowl), apartheid-era resettlements (Mitchells Plain) and post-apartheid urbanisation (Dunoon). Images from Google Earth



engagement with the centuries of literature on justice in how public goods are distributed, the scope of this article is limited to a more practical and policy-oriented perspective that can inform future decisions about how to pay for water services. Importantly, while our study was conducted immediately after Cape Town's drought, it does not elucidate whether the captured perceptions existed before that calamity or emerged as a result of it.

Past and present patterns of injustice

Nearly 3 decades after the formal end of apartheid, integration and equality still elude South Africa. With the world's highest economic inequality, class has to a degree replaced racial categories as the most salient social divide (Potgieter 2017; United Nations 2020). However, the government still distinguishes between black,¹ coloured, Indian/Asian and white residents (StatsSA 2020), and census data show that post-apartheid efforts to redress racial discrimination are held back by high unemployment, wage gaps and a divided labour force (Massey and Gunter 2019; United Nations 2020).

Cape Town's spatial form reveals these inequalities starkly. In the 'City Bowl', several affluent neighbourhoods

occupy the slopes of Table Mountain facing Cape Town's historical centre (Fig. 1). Shared for centuries mostly by white (European colonisers) and coloured residents (originally a British term for former slaves of mostly Malay origin and the indigenous Khoikhoi and San peoples of the Cape), apartheid policies designated most of City Bowl exclusively as 'white' and forced coloured families to relocate to areas like Mitchells Plain at the city's periphery (Hino et al. 2018; Maharaj 2019). Meanwhile, black South Africans were regularly forcibly removed to rural 'homelands', with few economic opportunities or public services. Black people were considered foreign citizens of these homelands and only allowed to reside in cities temporarily under strict control and to serve the needs of white employers (Turok 2013; Maharaj 2019; Battersby 2020). Apartheid's racial hierarchy established coloured neighbourhoods as physical buffers distancing white residents from the 'visiting' black labourers (Hammett 2010; Turok 2013; Maharaj 2019). Post-apartheid policies have enabled more permanent black urbanisation to areas like Dunoon, but many struggle with persistently high unemployment and low incomes, and informal structures and backyard shacks have rapidly come to dominate the streetscape (Lohnert et al. 1998; Turok 2013; Mahlanza et al. 2016). Mitchells Plain and other 'coloured' areas are mostly working class, as market forces and community ties limit mobility to more attractive neighbourhoods (Battersby 2020). Expensive areas in City Bowl are only gradually diversifying, as a more mixed middle class moves in and some white residents relocate to suburban gated communities, but prejudice and racism still create tensions (Leibbrandt et al. 2012; Inkeri 2019; Maharaj 2019). Official

¹ While the government and official census uses the term 'black African' as one of the four racial groups, we instead recognise and follow the common usage among respondents of the shorter 'black'. Importantly, these terms are fluid and sometimes contested; using them here is not intended to reify socially constructed divides.

statistics characterise Cape Town's population as 42.4% coloured, 38.6% black, 15.7% white, 1.4% Indian/Asian and 1.9% other (StatsSA 2021).

Water access and tariffs in Cape Town are shaped both by this history as well as events like the recent drought. Others have investigated the impact of increasingly market-based approaches (Smith 2004; Millington and Scheba 2020), justice implications of technologies to regulate water consumption (Mahlanza et al. 2016), the city's responses to the drought (Ziervogel 2019; Brühl and Visser 2021), the role of municipal finance (Simpson et al. 2019b), and residents' responses to restrictions and tariffs (Matikinca et al. 2020; Ouweneel et al. 2020). For this study, we note that Cape Town's tariffs are structured to cover all costs of water provision, and to make wealthy users subsidise free water for poorer ones (Simpson et al. 2019b). By design, using more water for gardens, swimming pools and appliances put affluent households in more expensive 'tariff blocks' (Smith 2004; Schreiner 2015; Department of Water and Sanitation 2018). However, many low-income households need to provide for both larger families and 'backyarders' renting shacks on the property. This can raise the collective water bill despite low per-capita usage and eliminate the system's redistribution mechanism (Smith 2004). This was also observed during the drought, when high-income households slashed non-essential water use while low-income ones could not reduce their consumption as much—but still used only half as much as high-income residents, counted per person (Ouweneel et al. 2020). The drought made matters worse for many poor also in other ways. As most wealthy households cut their use of municipal water, to the fully subsidised tariff block below the 6,000 L/month, the city's revenues plummeted. In response, it limited access to free basic water only to households that could prove and register as severely impoverished (Department of Water and Sanitation 2018; Simpson et al. 2019a, b; Brühl and Visser 2021). All who were reluctant to, uninformed about or incapable of registering as indigent, or simply were poor but not 'poor enough', saw their water costs increase while affluent residents experienced a net decrease due to greater relative cuts in water use (Millington and Scheba 2020; Brühl and Visser 2021).

When households are unable to pay, authorities face the choice of restricting access or allowing debts to accumulate. Leaky infrastructure and non-payment as a form of apartheid protest has also contributed to indebtedness (Smith 2004). Attempts to cut off water for households with unpaid bills have been opposed as they violate constitutional rights, leading the municipality to instead introduce 'water management devices' (WMDs) in 2007 (Smith 2004; Beck et al. 2016). WMDs are a type of water metre that cuts off supply at a certain amount, so that basic needs are provided while preventing overuse and facilitating leak detection (City of

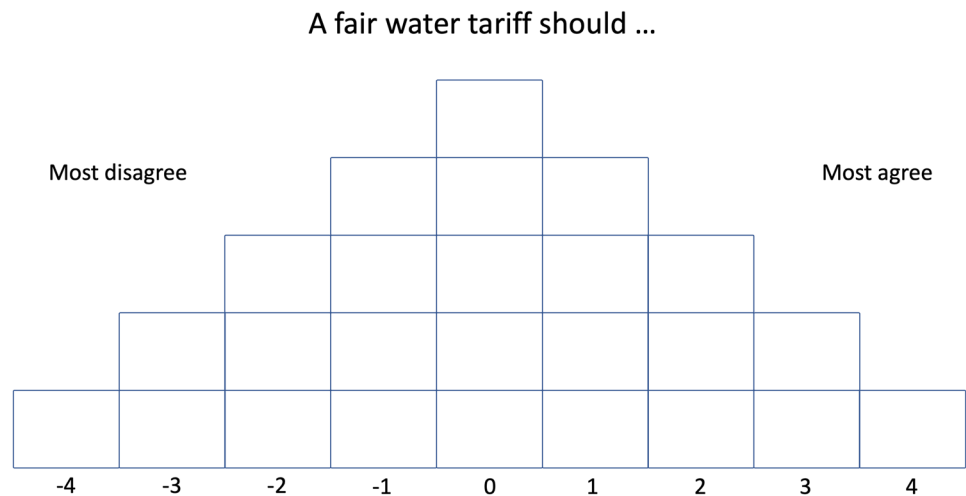
Cape Town 2007; Mahlanza et al. 2016). However, installations primarily targeted poor households and sometimes happened without adequate information or even consent, and devices sometimes leak or shut off supply erratically. Many, therefore, came to see WMDs as a tool for government control of and sub-standard services for historically disadvantaged groups (Mahlanza et al. 2016; Enqvist et al. 2020). Critique grew stronger during the water crisis as the City quadrupled the pace of installations, aided by tariff reforms forcing households to accept WMDs to qualify for indigent status (Millington and Scheba 2020). Increased costs and imposition of WMDs leave many residents deeply frustrated and sometimes resorting to informal or illegal alternatives to secure basic water needs (Enqvist et al. 2020). Mechanisms meant to safeguard the needs of e.g. larger or indigent households typically involve additional bureaucratic obstacles to obtain the same services as others (Yates and Harris 2018). In more affluent areas, households are often at or below the 'standard' size of four people, making it easier to comply with restrictions—especially since many can afford off-grid solutions including rainwater tanks and boreholes (Simpson et al. 2019a; Ouweneel et al. 2020). Policies designed only to cater for such households risk being deemed unfair and punitive towards those who live in low-income, crowded or informal settlements.

Methodology

Q method was first developed in psychology as a scientific approach to study subjectivity and how different viewpoints coexist and overlap (Stephenson 1953; Brown 1980; Watts and Stenner 2005). Using a small sample of twenty to forty people, Q method is not designed to provide representative, generalizable insights about a broader population, but rather combine statistically robust quantitative and qualitative analyses of the selected participants' viewpoints (Watts and Stenner 2012; Rutten et al. 2017). It helps bring initial coherence to complex issues and explore how perspectives on socially contested problems are interconnected (Stainton Rogers 1995; Watts and Stenner 2012). Further qualitative and/or quantitative research is usually employed to obtain a fuller picture. We employ it to draw a first outline of how subjective perspectives on fairness are interlinked with Cape Town's water challenges.

Central to the method are 'Q-sorts', produced by asking participants to sort a list of statements along a subjective scale such as 'most agree' to 'most disagree' (Sumberg et al. 2017). The Q-sorts are then clustered using factor analysis, identifying areas of common ground among participants and allowing for any "shared modes of engagement, orientations or forms of understanding to be detected" (Stenner et al. 2000, p. 442).

Fig. 2 A Q-grid was printed out and used to let respondents rank the 25 statements according to how much they disagree or agree with them by placing one statement in each grid cell



Statements for the Q-sorts

We compiled a list of normative statements about water tariffs and fairness during the peak and end of the water crisis in 2018 and early 2019. Sources included scientific publications, news articles, public meetings organised by the municipality, online discussion forums, platforms designated to collect public opinions, and open-ended conversations with key informants with insights into lives in informal settlements and with academic expertise about water governance in Cape Town. This process continued until we reached saturation, when no substantially new perspectives were emerging and our sample met the criterion of reaching beyond what most people could be expected to agree with (West et al. 2016). This resulted in about 40 statements, which were used to pilot the sorting process. Here, respondents' input helped us further reduce the statements to 25 by eliminating overlapping meanings, producing a less overwhelming but still mostly comprehensive set of viewpoints. Smaller Q-sets are sometimes necessary to avoid overly demanding sessions, and can be sufficiently rich if winnowed down from a larger initial set (Watts and Stenner 2012; Sumberg et al. 2017). The piloting also helped simplify statements wording and make the exercise accessible to people with different educational backgrounds. We settled on phrasing statements to start with “A fair water tariff should...”, and printed them on laminated cards that respondents placed on a ‘Q-grid’ to indicate level of agreement (Fig. 2).

Participant selection and data collection

Q method does not rely on representative samples, but rather seeks participants that will express diverse opinions about a given subject (West et al. 2016). Participants should not be indifferent to the issue, and ideally express “a particularly interesting or pivotal point of view” (Watts and Stenner 2012

p. 71). Water issues were likely to concern most Capetonians after the recent drought, and we sought diverse perspectives by inviting participants from three areas: City Bowl, Mitchells Plain, and Dunoon (Fig. 1). The assumption was that the vastly different historical and socioeconomic contexts would help us capture a wider range of views, despite initially relying on a convenience sample through personal and professional networks. To further reduce bias, this was complemented by snowball sampling where we explicitly asked respondents to recommend participants they thought would offer a different perspective than their own. In total, we interviewed thirty respondents, which generated 27 useable Q-sorts: eight each from Dunoon and Mitchells Plain, and eleven from City Bowl.

Respondents were interviewed individually, at locations chosen by them. We presented the purpose (to understand respondents' personal opinions) and the Q-sort process thoroughly, and instructed the respondents to carefully read all 25 statement cards. Next, they were asked to sort the cards into three stacks that they generally agreed with, disagreed with, and felt neutral about. Lastly, the respondents arranged all cards on a ‘quasi-normal’ grid (Fig. 2) to specify their level of (dis)agreement with each statement. Cards had to fill all positions on the grid, producing a ‘relative weighting’. This means that respondents do not necessarily feel neutral about statements placed in the middle column, for instance, they just agree with them *less than* those placed closer to “Most agree”. We intentionally included some statements around similar topics, one worded positively and the other negatively, to minimise the risk that a respondent would agree or disagree with all statements (e.g. statements 2 and 6, or 9 and 10, see Table 1). Having said this, Q method is primarily intended to study patterns at group level, rather than analysing specific respondents' viewpoints.

Table 1 Ideal sorts for the five factors

Statements: 'A fair water tariff should...'	Factors' ideal sorts				
	F1	F2	F3	F4	F5
1 ...be higher for households with high property value.	0	-3**	+2	+3	-1
2 ...work to counteract economic inequality in society.	0	+1	+3**	0	-1**
3 ...have higher rates in higher income areas.	+2	-2	+1	+2	0
4 ...be set through a process where citizens participate and share their perspectives.	+1	+4**	+1	+1	+2
5 ...allow residents to pay for the amount they think they have used.	-2	0	-4**	0	-2
6 ...be equal for all and not take any consideration of economic inequality.	-2	0*	-3	-3	+1*
7 ...be increased each year in direct proportion to the inflation rate.	-3	-1	-1	-1	-3
8 ...be continuously adjusted according to the dam levels: the higher the dam levels, the lower the tariff.	-4*	-1	-1	+1	+3
9 ...ensure that everyone pays for the water that they use.	-1	+1	+2	-1	+1
10 ...provide a basic amount of water for free for those not able to afford this.	+4	0**	+1**	+3	+4
11 ...take into consideration the number of people living in each household.	+3**	-1	0*	-3*	-2
12 ...be lower for citizens who do not use water for recreational purposes such as filling pools and watering gardens.	+2	-2**	0	+2	+1
13 ...ensure that all money paid by consumers goes to water related expenses only.	-1	+3**	-2	0	-1
14 ...have prepaid options for low-income areas.	-1	+2**	-1	-2	-4
15 ...give rebates for pensioners.	+3	+1	0*	+4	+2
16 ...be lower for households where the City has installed water management devices.	+1	0	-2	0	-2
17 ...be a flat rate which does not take into consideration the amount of water used.	-3	-3	-3	-4	-3
18 ...be used to raise money for extending access to water in underserved neighbourhoods	0	-2	+2	-1	+1
19 ...encourage water conservation by charging consumers higher rates for water they use beyond the restrictions set by the government.	+1	+1	0	+1	0
20 ...include a fixed cost for maintenance and upgrade of existing infrastructure, and a cost determined by how much water the consumer has used.	0	0	+1	-1**	0
21 ...be directly proportional to the amount of water used, regardless of income, property value or residential area.	-1	+2**	-2	-2	0
22 ...include a charge to consumers for upgrading the city's infrastructure to provide water from new sources.	0	-1	-1	-2	+3**
23 ...be easily understood, provide clear information on how much water has been used and at what cost.	+2	+3	+4	+2	+2
24 ...be based on a transparent and accessible budget over the City's water related costs.	+1	+2	+3**	0	0
25 ...be higher in the dry summer and lower in the wet winter.	-2**	-4**	0	+1	-1

Statements 17 and 19 (shaded) are 'consensus statements' where no statistically significant difference was found between any factors (at $P < .05$ for 17 and $P < .01$ for 19)

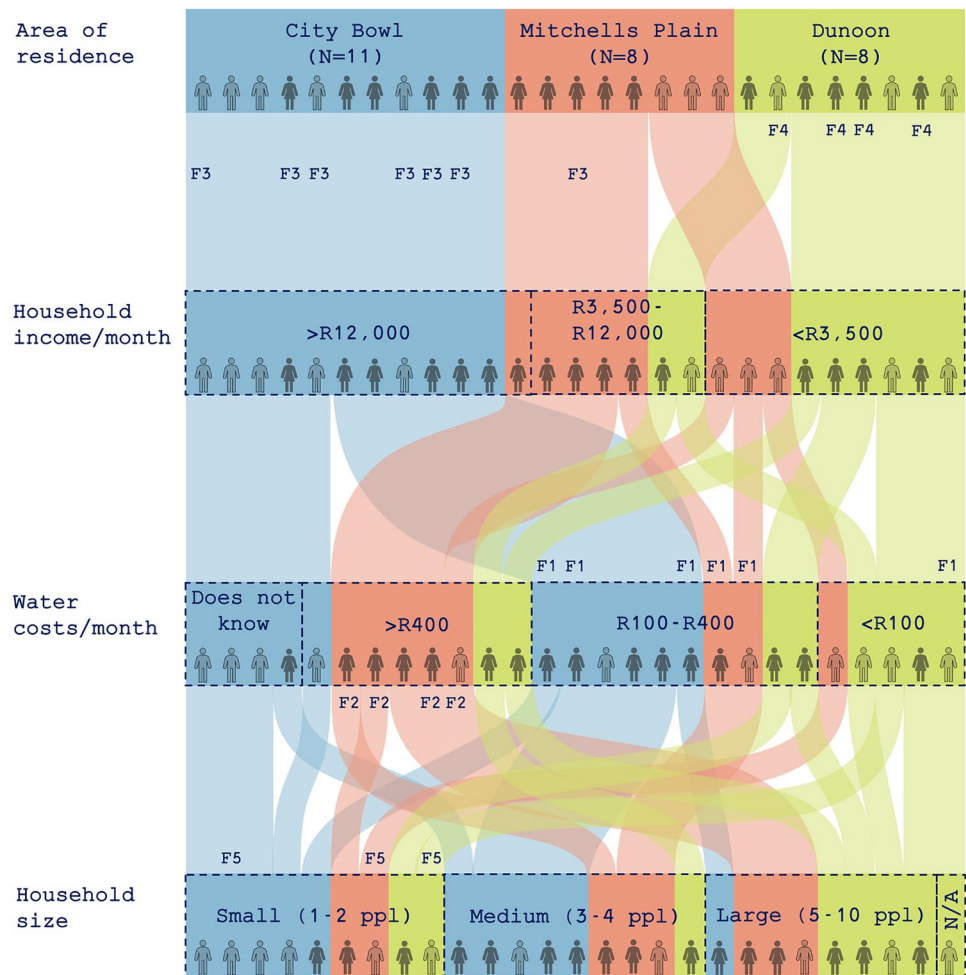
Asterisks indicate that a particular factor's score differs significantly from other factors', with * at $P < .05$ and ** at $P < .01$

Analysis and interpretation

Q method assumes that by identifying groups of similarly sorted statements, one can describe different 'types' of viewpoints, or framings of a certain topic (Watts and Stenner 2012; West et al. 2016). Using PQMethod software (Schmolck 2014), we calculated intercorrelations between all 27 Q-sorts to conduct a principal component

analysis. In essence, this compares how similar or different the respondents were in terms of how they sorted the 25 statements. The analysis groups similar Q-sorts into bundles, each representing a cluster of respondents that are more similar to each other than to the rest. Following West et al. (2016), we applied a varimax rotation to identify a 'factor' for each bundle, i.e. an 'ideal sort' that best represents an aggregate of the collected Q-sorts. Each

Fig. 3 The coloured bands represent the groups of interviewees (women in dark grey, men in transparent) from the three study areas, and shows how they align according to three household characteristics. Households in Mitchells Plain report the highest monthly water costs, despite having fewer dwellers per home compared to Dunoon, and while earning lower incomes to pay these costs compared to City Bowl households. Respondents whose Q-sort correlates significantly with a factor have that factor indicated (F1–F5), in places that illustrate important similarities within that group. For instance, all respondents associated with factor 2 have very high monthly water costs, while respondents associated with factor 5 all live in small households



factor represents “a common viewpoint broadly shared by a number of respondents” (Davies and Hodge 2007, p. 326). Eight factors emerged in the sorting, of which three were eliminated since they were each only correlated with one respondent’s Q-sort. This was based on the PQMethod software which indicated if respondents’ Q-sorts were significantly correlated ($p < 0.01$) with a factor by exceeding a factor loading of ± 0.516 , based on the following equation: $2.58 \times (1/\sqrt{n})$, where n is the number of statements ($2.58 \times (1/\sqrt{25}) = 0.516$) (Brown 1980, p. 222). In our case, 24 of the 27 Q-sorts loaded significantly on the five factors, which together explained 61% of the variance in the sample (comparable to similar studies, e.g. Davies and Hodge 2007; Bischoff-Mattson et al. 2020). These factors were also assessed qualitatively and deemed to be distinctly different from each other in ways that were relevant to the study, and displayed internal coherence in terms of how the statements were weighted.

For each factor, PQMethod produced an ‘ideal sort’ based on the Q-sorts in the bundle associated with that factor. These ideal sorts (Table 1) were analysed qualitatively using crib sheets (Watts and Stenner 2012; West et al. 2016)

to provide a systematic, data-driven way to characterise and compare all five factors. The crib sheets help identify what makes each factor unique, and what similarities exist with other factors. This is summarised below in concise narratives for each of the factors.

Results: ‘A fair water tariff should...’

The 27 people that completed a Q-sort include teachers, bus drivers, domestic workers, lawyers, researchers, tourist guides, homemakers and some not currently working. A majority were female (16 of 27), just over half owned the homes they live in (15 of 27) rather than rented, all had running water in their home or in their yard, and none had a borehole. Comparing household income, costs for water use and household size across the three areas (Fig. 3), several patterns emerge: City Bowl households are the smallest but earn the highest total income; Dunoon has the highest share of large households and low incomes, and pay the lowest water bills; while Mitchells Plain residents have higher water bills than elsewhere—perhaps because

A fair water tariff should...

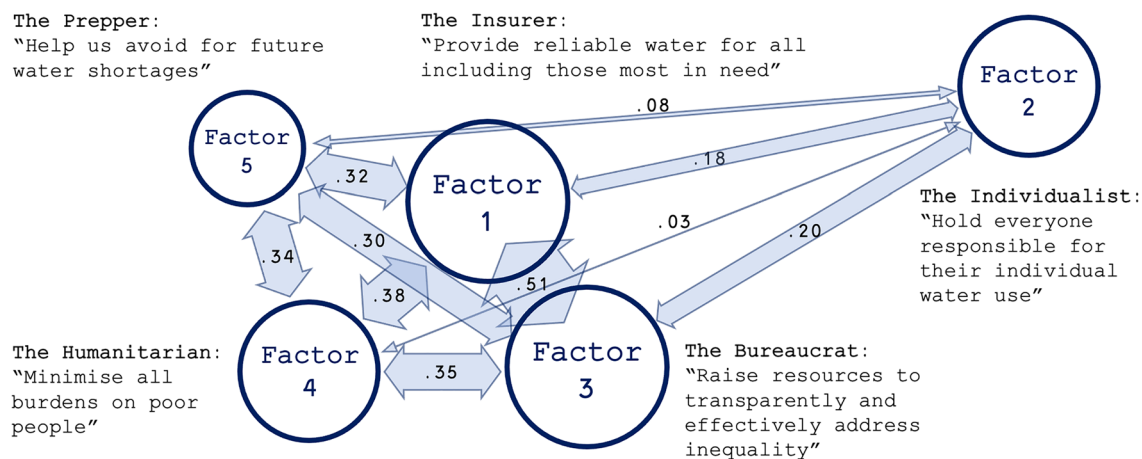


Fig. 4 Visualisation of the ‘landscape’ of factors identified in the sample, with correlation values (0–1) shown in arrows and represented by arrow thickness and approximated in the distance between each factor—thicker arrows and closer proximity representing greater

similarity. Factors with large circles each explain 15% of the sample variation, medium circles 11%, and the small circle 9%. Each factor has a statement that highlights the essence of what distinguishes that factors’ view on fairness

households are larger than in City Bowl, leading to higher water consumption, while slightly higher incomes compared to Dunoon means fewer qualify for free water. This indicates that although our sample was not representative in a statistical sense, selecting participants from these three areas did allow us to collect perspectives from people that represent different socioeconomic circumstances and experiences of water services delivery.

Respondents’ Q-sorts can be understood through five factors (Table 1), each representing a viewpoint at least partially distinct from the rest (Fig. 4). Two of the 25 statements had broad consensus among all viewpoints: all agree that it would be unfair to charge a flat rate independently of how much water a household has used (statement 17), and none express strong feelings about the fairness of using tariffs to encourage water conservation (statement 19). Below, we present each factor by describing the respondents whose Q-sorts most closely align with it, and summarise the ideal sort patterns in brief narratives where statements are referred to by their number in Table 1. The narratives describe five fictional characters—the Insurer, the Individualist, the Bureaucrat, the Humanitarian, and the Prepper—to illustrate distinguishing statements unique to a character, and their ‘strongest views,’ i.e. a statement sorted very high or low even if it is one shared with other factors. Importantly, these characters do not necessarily represent actual respondents, but rather the aggregated subjective perspectives emergent from each Q-sort cluster.

The Insurer: ‘Provide reliable water for all including those most in need’

Factor 1 explains 15% of the sample variance, and six respondents’ Q-sorts are significantly correlated with it. They mostly have medium water costs and live in medium-sized households, and include teachers, construction workers, researchers, homemakers, and unemployed.

This factor represents the Insurer: the view that fair water tariffs need to promote stable and secure access to water. Rates should not fluctuate with seasonal dam level changes (8*, 25**), but should take into account the number of people living in each dwelling (11**). Households with a WMD or that do not use water for gardens and pools should have a lower rate (16, 12). Similar to the Humanitarian and Prepper, the Insurer strongly supports giving rebates to pensioners and free basic water to the poorest (15, 10); she also agrees with the Bureaucrat and Humanitarian who want the wealthier to pay a higher rate (3, 6, 21). The Insurer values access to information and input on the city’s water costs, but not more so than others (4, 23, 24).

The Insurer is most similar to the Bureaucrat and the Humanitarian through her support of redistributive tariffs (Fig. 4). She differs from the Bureaucrat by placing less value on the need for transparent information to residents, and from the Humanitarian by valuing stable, predictable rates.

The Individualist: ‘Hold everyone responsible for their individual water use’

Factor 2 explains 11% of the sample variance, and correlates significantly with four respondents’ Q-sorts. These all hold various jobs at a school in Mitchells Plain, and have relatively high water bills (Fig. 3).

This factor is the Individualist, who unlike others thinks fairness is when everyone pays the same rate per unit of water used (21**, 9), independently of property value, household income, or whether the water is used recreationally (1**, 3, 12**). You pay for what you get, and you get what you can pay for. The Individualist alone prefers prepaid options (limiting use to what can be afforded) over free basic water to the poorest (10**, 14**). Tariff revenues should only go to water-related expenses (13**), and not to improve services in underserved neighbourhoods (18). The Individualist shares others support of access to information about one’s own water use and the city’s budget (23, 24), but is the strongest advocate for citizen participation in determining the tariffs (4**). Tariffs should definitely not be season-dependent (25**).

The Individualist’s aversion to pro-poor measures and strong preference for active citizen involvement makes her the most unique and different viewpoint in the study. Her closest links are to the Insurer and the Bureaucrat, who share her preference for budget transparency.

The Bureaucrat: ‘Raise resources to transparently and effectively address inequality’

Factor 3 explains 15% of the sample variance, and has seven respondents with significantly correlating Q-sorts. All but one live in the City Bowl, all in households with no more than four members; most are well-paid, educated professionals such as lawyers, economists, and researchers who either have a moderate water bill, or do not know its size.

This is the Bureaucrat, who thinks fair water tariffs require the City to be transparent about water-related costs and share accessible information about the costs to end users (24**, 23). She is the staunchest advocate for using the tariffs to counteract economic inequality in society (2**, 6, 21). However, while she supports charging the wealthy more based on property value and providing the poor’s basic water needs for free, others advocate for such ideas more strongly (1, 10**), and the Bureaucrat is the most sceptical of blanket rebates to pensioners and households with WMDs (15*, 16). Rules are important and paying based only on one’s own estimates of usage is deeply unfair; the cost should be linked to the actual amount of water consumed (5**, 9). Compared to others, the Bureaucrat has more trust in public works and acceptance for extra fees to maintain infrastructure, extend

services to underserved neighbourhoods, or even other non-water expenses (13, 18, 20).

The Bureaucrat is quite similar to the Insurer and the Humanitarian, but stands out in her stronger emphasis on budget transparency and information access as a way to counter economic inequality, rather than broad rebates to all potentially disadvantaged groups.

The Humanitarian: ‘Minimise all burdens on poor people’

Factor 4 explains 11% of the sample variance. The four significantly correlating Q-sorts all come from respondents living in Dunoon, who did not state a profession and have low-to-medium incomes and water costs. Three of these four respondents live in large households (Fig. 3).

This is the Humanitarian, who views water tariffs as fair if they relieve the struggles of society’s most vulnerable. Like others, she supports pensioner rebates, free basic water if you cannot pay, and lower rates if you only use water for essential needs (10, 12, 15). It is unfair to make everyone pay the same rate for water (6, 9, 21). The Humanitarian strongly supports higher rates for people with more valuable properties and higher income (1, 3), and is the strongest opponent of households being required to help pay for infrastructure upkeep, upgrades or extensions (20**, 22). She values clear and accessible information about residents’ own water use and costs, but sees little value in access to the city’s budget for water-related costs (23, 24). The Humanitarian does not think tariffs should consider how many people live in each household (11*).

The Humanitarian is similar to the Insurer, the Bureaucrat and the Prepper in her support of various pro-poor policies, but she has little interest in active citizen participation and primarily just wants to cut all costs that risk burdening households more.

The Prepper: ‘Help us avoid future water shortages’

Factor 5 represents the least common viewpoint, explaining 9% of the sample variance and correlating significantly with just three Q-sorts. The three respondents all live in different areas, are all male, and live in small households (Fig. 3).

This ‘Prepper’ perspective seems highly concerned about future sustainability of water supply and sees it as fair to use tariffs to address this problem. No one else approves as much of using water revenues to explore new water sources, and using water tariffs to discourage consumption when dam levels are low (22**, 8). Everyone should ideally contribute equally to this and pay the same rate; it would be unfair to use tariffs as a tool to counteract economic inequality in

society (2**, 6*). However, the Prepper agrees that those who cannot afford basic water needs should get it for free, and he opposes prepaid options for low-income areas more than others (10, 14).

The Prepper is unique from all others by linking fairness to awareness of water scarcity and sustainability concerns. This needs to be balanced with social goals, which the viewpoint is somewhat conflicted about.

Discussion

Subjective experiences and water governance priorities

The five viewpoints identified in our study reflect respondents' subjective ideas of fairness. To some, it means ensuring stable water supply for all; to others, it is about equal individual responsibility; one viewpoint emphasises transparent public funds to address inequality; another simply wants to remove any burden on the poorest; and one group associates fairness with promoting long-term water availability. These viewpoints are not a definitive representation of all Capetonians, but they help us unpack some differences between respondents in three key areas and illustrate how subjective perceptions of justice can be.

It is useful to contextualise the findings by reminding ourselves that the controversy surrounding water tariffs stems not only from disagreeing residents, but also from the multiple functions that tariffs have in Cape Town's water governance. In addition to covering expenses, they are used to discourage overuse of water, and to fairly reallocate costs and benefits between users (Simpson et al. 2019b; Ouweneel et al. 2020). Cost recovery, demand management and social needs are pressing challenges both nationally and internationally (Ruiters 2013; Zetland and Gasson 2013; Dos Santos et al. 2017; Flörke et al. 2018). Low-income countries often address the social aspects through block tariffs that charge the richest residents enough to subsidise water for the poor as an essential good (Boland and Whittington 2000; Jansen and Schulz 2006; Sibly 2006). Some advocate that in contexts like South Africa's, where water basins are stressed and rainfall variable (Schreiner 2015), tariffs should reflect the actual cost of consumed water services to incentivise conservation and minimise public subsidies (Ruiters 2013). Block tariffs are criticised for sending the 'wrong signal' by confusing users with the different blocks and rates (Boland and Whittington 2000) or by not incentivising water conservation 'within' blocks, since rates only drop if users decrease consumption to a lower volume block (Sibly 2006). However, minimising

water consumption is not always desirable; essential water use (for food preparation, hygiene) cannot be limited the same way non-essential use (for lawns, swimming pools) can, which means that households using less water often have little room to make further savings. Raising tariffs in starkly unequal societies, therefore, risks putting a disproportionately high economic burden on poorer households—or even undermining public health and wellbeing (Eberhard 1999; Humphreys and Enqvist 2022).

Distributive justice

Of all the statements in our investigation, respondents most clearly agree that it is unfair to use large amounts of water without paying extra. This indicates that accountability and responsibility are important: do not waste water. Four of five viewpoints also agree that tariffs should consider social needs and support society's poorest. Replacing the block tariff with equalised rates would, therefore, likely be rejected as unfair.

That said, Q method is not necessarily representative and one dissenting viewpoint may still reflect a broadly popular opinion (Iribarnegaray et al. 2014). In our case, the Individualist opposes pro-poor tariffs the most. The view is associated with respondents who are themselves hardly privileged: low-paid working-class residents in Mitchells Plain (Fig. 3). Interestingly, block tariffs are sometimes criticised for creating conflicts of interest between poor people in the lowest block, who risk higher rates to fund service extensions, and the 'even poorer,' who would benefit from access to subsidised public services instead of pricier informal supply (Zetland and Gasson 2013; Barraqué and Montginoul 2015). The Individualist's support for prepaid water access in low-income areas (statement 14**), aversion to free basic water (statement 10**) and to extending access to underserved neighbourhoods (statement 18) suggests a similar tension in our case. Notably, the viewpoint rejects higher tariffs for the rich (statement 1** and 3), even though Individualist respondents have higher water bills than people in both wealthier and poorer areas (F2 in Fig. 3).

Procedural justice

The Individualist's position shows unique disapproval of redistributive mechanisms, and respondents associated with it all have disproportionately high water bills. This, we argue, suggests a stronger sense of injustice regarding the current system compared with the other viewpoints. Previous studies have shown that when stakeholders find outcomes to be unfair, they become more concerned about procedural justice (Wutich et al. 2013). Our findings support this: the Individualist is also the strongest supporter of

involving citizens in the process of setting tariffs (statement 4**).

Procedural justice also helps us understand some nuances among the four other viewpoints. While broadly supporting distributive justice, they all differ in the mechanisms they think can best deliver it: the Insurer favours generous rebates and stable rates for users, while the Bureaucrat prefers transparent budgets and effective government programmes; the Prepper believes in balancing pro-poor support with ensuring long-term water sustainability; and the Humanitarian instead mistrusts government interventions and simply wants improved water services for the poor. This last position is particularly interesting, as it indicates a general mistrust in formal processes. It is associated with residents in Dunoon, where negative experiences of WMD installations have caused conflicts with authorities for years (Mahlanza et al. 2016). When the installation pressure increased and devices were made mandatory for indigent households during the water crisis, it effectively limited free water access for the poorest (Millington and Scheba 2020). This runs directly against what the Humanitarian views as fair (statement 10, 21). Introducing new policies when views diverge on how to best accomplish a goal can cause misunderstandings and mistrust (Iribarnegaray et al. 2014). This has also been found in many informal settlements, where residents often rely on informal support networks since formal service delivery is not trusted (Enqvist et al. 2020).

Interactional justice

Resource scarcity and perceived unfairness in outcomes generally make interactional justice more relevant (Miller 2001; Wutich et al. 2013). In Cape Town, many people's experiences of authorities' conduct and treatment are influenced by the historical legacy of segregation and discrimination that underpin many unresolved socioeconomic divides (Lohnert et al. 1998; Levenson 2017; Maharaj 2019). Here, we reflect on how this could have shaped three perspectives of justice that are each strongly associated with respondents from a specific study site: the Individualist (Mitchells Plain), the Humanitarian (Dunoon) and the Bureaucrat (City Bowl).

The Individualist favours a transparent system and minimal spending on pro-poor interventions. The viewpoint is only found in Mitchells Plain, still dominated by coloured residents who under apartheid were subordinated to white people but given more rights than black South Africans (Turok 2013; Battersby 2020). Subsequent policies to eradicate apartheid discrimination have among some created a sentiment that coloured people face new disadvantages and feel more disempowered as black people have more economic opportunities and whites retain most economic power (Hammett 2008; Potgieter 2017). Paying more than others for water (Fig. 3) could create a similar perception

among Individualist respondents, i.e. that the (tariff) system is biased against coloured people—although class is a more likely explanation: poorer households can qualify to get free water, and more affluent residents tend to live in smaller household which helps avoid the higher tariff blocks.

The Humanitarian prefers free basic water for society's poorest but mistrusts government programmes. The associated respondents all reside in Dunoon, the mostly informal settlement that has emerged largely through post-apartheid migration from poor rural areas in the Eastern Cape (Mahlanza et al. 2016). This also means moving from the province with the lowest degree of access to piped water, to that with the highest (StatsSA 2011). Migrants used to freely available water in rural well points and rivers can be hesitant to rely on costly service provision by an authority (Rodina and Harris 2016). Trust may also be eroded due to the previously described conflict around WMD installations in Dunoon, leaving a sense that the impact on “the poorest of the poor” goes unrecognised by the municipality (Mahlanza et al. 2016, p. 375). Such experiences of authorities' conduct could contribute to the Humanitarian's view that fairness requires that poor people are burdened as little as possible.

Lastly, the Bureaucrat differs from the other two by expressing a guarded optimism that public authorities can—if run transparently—deliver amenities justly by charging wealthy households more to extended services to society's most marginalised. This view is linked to residents in affluent City Bowl (and one domestic worker employed in such a household), i.e. mostly those who have either avoided racial discrimination by being white, or found socioeconomic opportunities in the post-apartheid era (Maharaj 2019). Many have benefited from past policies to build a white middle class (Hino et al. 2018) or more recent reforms to allow a more diverse one (Battersby 2020). Having experienced this treatment by governments could increase the likelihood of trusting (and agreeing to pay for) further public programmes for poverty alleviation.

While these three histories provide possible explanations for how different senses of interactional (in)justice might have emerged, our study cannot verify any such causality. Past and present experiences of government discrimination are a more complex topic than these viewpoints capture and have been explored in a greater detail by others (Hammett 2008; Turok 2013; Rodina and Harris 2016; Maharaj 2019; Battersby 2020). Our findings do, however, seem to support previous claims that in order to avoid people rejecting an intervention as illegitimate or unacceptable, it is critical to ensure that it is not perceived to ignore residents' particular positions and needs (Heino and Takala 2015; Mahlanza et al. 2016).

Importantly, perspectives on justice do not all align with class or racialised geography. The Insurer and the Prepper

are represented in all three study areas, by respondents from the highest to lowest income groups. Both have a more temporal understanding of fairness that complements distributive, procedural and interactional interpretations. The Insurer's preference for stable rates and predictable, uninterrupted water access focuses on security in the immediate future. The Prepper's concern for dam levels and ensuring future water supply instead signals a heightened awareness about longer term climatic uncertainty—perhaps indicating a more intergenerational perspective on justice (Howarth 1992; Thiery et al. 2021).

Lessons for fair and sustainable water tariffs in an urbanising South

Authorities' response to Cape Town's drought has been both praised for avoiding a disaster, and criticised for poor communication and unfair impacts on residents. This study does not claim any causality between the water crisis and the identified views on fairness, but the crisis illustrates the growing urgency of water shortage and the relevance of understanding issues of environmental justice. This is evident in the challenge of using water tariffs to achieve both demand management, cost recovery and social goals. A public outcry in 2018 showed that increasing rates to secure revenue was viewed as unjust given people's unprecedented water cuts (CBN 2018; The Mail and Guardian 2018; Brühl and Visser 2021). A year earlier, similar protests were sparked by tariff reforms to make free water to the city's poorest contingent on household registration and technological control through WMDs (Millington and Scheba 2020). While raising tariffs can help reduce water use even among low-income households that already have low water demands, such measures put a disproportional pressure on the poorest to bear the burden of water conservation—either using less water than wealthier neighbours, or incurring higher water bills (Ouweneel et al. 2020). Meanwhile, wealthier households can more easily avoid this by investing in water-saving technology (Simpson et al. 2019a).

In South Africa and globally, water services' policies increasingly require utilities to recover all costs from its users (Barraqué and Montginoul 2015; Millington and Scheba 2020). When Cape Town authorities moderated the 2018 tariff raise by cross-subsidising the revenue shortfall, this was seen as “short term measures [that] are not sustainable and cannot be relied upon going forward” (Department of Water and Sanitation 2018, annexure B page 1). Compared to the extensive agricultural subsidies for (predominantly white) farmers' water needs during apartheid (Schreiner 2015), this suggests another interactional injustice: if cost recovery could be ignored when catering to the most privileged, then why should those still struggling to catch up accept anything less? Similarly, many wealthy

countries subsidised water as a necessary public good until the mid-twentieth century, before the idea took hold that it should fund itself (Barraqué and Montginoul 2015). Sub-Saharan Africa's urban population is expected to triple by 2050, largely through expansion of informal settlements (Dos Santos et al. 2017). Providing safe, reliable and accessible water using only the rates paid by end users risks excluding low-income households from access to water services and from municipal attention more broadly (Barraqué and Montginoul 2015; Sarkar 2020). Informal vendors often fill the gap but are often pricier and associated with their own suite of injustices (Wutich et al. 2016; Sarkar 2020). Cost recovery regimes, therefore, run the risk of burdening low-income households the most, especially given the water risks associated with increasing climate uncertainty. That said, many cities in the region have socioeconomic and hydrological characteristics that vary vastly from Cape Town's (Leal Filho et al. 2022), requiring insights from this study to be interpreted with caution.

Residents' subjective experiences are critical for avoiding deepened inequalities being seen as unfortunate but unavoidable consequences of natural dynamics of the system (Millington and Scheba 2020; Ziervogel et al. 2021). Formal water managers that are disconnected from users' perspectives risk viewing them as “uncooperative, distrustful and even ignorant squanderers of water” (Iribarnegaray et al. 2014, p. 912). As the Cape Town case shows, whether or not a tariff system is seen as fair not only depends on how costs are distributed, but also whether the system adequately acknowledges people's different circumstances. The city's new Water Strategy, finalised after the drought, explicitly refers to a fair distribution of costs and benefits as instrumental for growing inclusivity and trust. Tariffs “need to be transparent and fair” (p. 28), but fairness is not defined and the strategy presents several normative statements about tariffs without acknowledging that some may disagree with them (Water and Sanitation Department 2020). To ignore this risk could undermine the aims and overall legitimacy of the strategy, if it implements measures that some residents find deeply unfair. The five perspectives we have described help illustrate nuances in how the public might perceive fairness. However, they should be seen as propositions that need further testing. It would also be of tremendous value to conduct a similar investigation that includes respondents within municipal government and local and national water departments. This would provide further insights into opportunities for collaboration and compromise between service providers and water users. Such work would benefit both from quantitative tools and more representative samples, and qualitative approaches that can go deeper to unpack the links between personal experiences, social dynamics and people's views on how to fairly share the costs of adequate water services.

Conclusion

Shrinking planetary ‘operating space’ to ensure safety and wellbeing for all is rapidly making justice a critical consideration for environmental sustainability. Scientific tools to understand subjective perspectives are, therefore, increasingly relevant and necessary to inform environmental science and policy. This study identifies five interpretations of fairness in water tariffs, under extraordinary but increasingly relevant conditions with great inequality and a recent existential water scarcity crisis. These mostly agree about distributive justice (that society’s poorest deserve assistance), but opinions vary regarding procedure (how to deliver such assistance). Moreover, we demonstrate the relevance of interactional justice for considering how past and present conduct towards citizens shapes ideas of fairness, exemplified with sentiments from respondents in informal settlements, working-class townships and affluent neighbourhoods. Subjective perspectives help recognise how costs for service delivery are experienced and perceived differently, and provide a useful lens to understand the tension between social needs, cost recovery and demand management when designing water tariffs. This is necessary to avoid burdening the lowest income households during resource scarcities—a critical challenge for rapidly urbanising sub-Saharan Africa where climate change threatens informal settlements’ residents in particular.

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