Title: Understanding residential water-use behaviour in urban South Africa

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Abstract

South Africa's water supply is under great pressure as demand continues to rise. Demand mitigation strategies implemented by the Department of Water and Sanitation (DWS), water boards and local authorities, and a few water awareness initiatives by private sector companies, non-governmental organisations (NGOs), and the media, have had some success, but domestic consumption remains high. In this chapter, we provide some background to current household water use behaviour from selected research conducted over the past 10 years and more particularly in the recent past as a result of the severe regional drought. We also provide a brief overview of some of the interventions which have been used by different metropolitan municipalities to curb water consumption. We then introduce a new study by the CSIR, in which we will delve deeper into residential water use and behaviour. This study will focus on the issue of attitudes of households to their water consumption in a search for ways in which domestic demand for water in South Africa's urban areas may be measurably reduced. The paper aims to bring to the fore the complexity of the forces shaping demand and water use. In so doing, it further aims to inform public policy regarding strategies and actions to reduce consumption and/or provide alternative domestic supplies of potable water.

Introduction

Freshwater is increasingly being used beyond sustainable levels (Postel, 2000). In many parts of the world people have grappled with the water supply challenge and several dozen solutions have been implemented. There is no shortage of proposed technological 'fixes': by increasing supply at the macro-scale through major desalination plants, constructing more dams, tapping underground water supplies, recycling industrial wastewater, and at the micro or domestic scale by installing water tanks, recycling household 'grey' water, and other domestic adaptations. There is also a plethora of initiatives to reduce consumption by using water efficient fittings within the home and by encouraging changes in gardening practices (Randolph and Troy,

2008). However, these interventions do little to bring about widespread change in water use attitudes and behaviours.

In terms of meeting basic household needs, a USA-based study by Gleick (1996) estimated that 13.2 gallons (or roughly 50 litres) of clean water are required per person per day for human needs (drinking, sanitation, hygiene, and food preparation). Of course, this is based on water consumption patterns in the United States of America (USA), a more water abundant country with more developed water infrastructure, and a very different socio-economic/political and biophysical context than South Africa. Even so, the USA situation does provide a global benchmark because of the country's large urbanised human population.

In South Africa, bar a few studies (particularly one on behavioural nudges conducted by the University of Cape Town) researchers have conducted little research on residential water use attitudes and household behaviour. The 1997 National Water Services Act (RSA, 1997) and the National Water Act of 1998 (RSA, 1998) outline the goals of water supply. These Acts aim to ensure the "right of access to basic water supply." A "basic" supply means 25 litres per person per day, easily accessible within 200m of the household. In July 2001, free basic water became a national policy through a revised tariff structure that included at least 6 000 litres of free water per month (i.e. 40 litre/capita/day for a family of five or 25 litre/capita/day for a family of eight). Government gradually implemented the policy within each designated metropolitan municipality' jurisdiction.

However, South Africans use much more than 6 kilolitres per month. Studies carried out in 2015 show that the average South African suburban family of 4 uses 300 litres per person per day.

This equates to:

=300 litres x 4 people
=1200 litres per day x 30 days
=36,000 litres per month x 12 months
=432,000 litres per year

Thus, the average South African uses six times more water than what was estimated by Gleick in terms of actual consumption, and 12 times more than the guideline prescribed in our legislation.

Despite South Africa's severe drought with most metropolitan areas instituting water restrictions, many South Africans still consume more water than the global average. Nevertheless, research indicates that with climate change, water supply will become more variable due to groundwater salinisation and increased rainfall variability (Bates, Kundzewicz, Wu, & Palutikof, 2008; Kundzewicz et al. 2008).

Figure 1. Current water supply in a peri-urban area in South Africa (Source: Photo taken by Elliot Moyo, CSIR, 2016)

Additionally, research also shows a direct relationship between increased access and amplified water wastage. A study conducted by the Council for Scientific and Industrial Research (CSIR), confirmed that increasing access to water leads to increased water wastage (Strydom, 2009). Personal communication with municipal water managers for yet another CSIR project suggests similar trends. In certain areas up to 50% of purified water is wasted due to the non-maintenance of household infrastructure, particularly in indigent households i.e. if you do not pay for something you will not appreciate it.

Researchers, therefore, have argued that rather than focusing on increasing freshwater supply alone, we also need to reduce water demand (Christian-Smith, Gleick, & Cooley, 2011). Demand-side policy responses to future freshwater variability will benefit from a deeper understanding of current household water use, perceptions of water use and the drivers of household water use behaviour. Such deeper understanding addresses key questions such as: do South Africans understand that the country is semi-arid with limited water resources, and that for example, most of the water used in the industrial hub of Gauteng is imported from Lesotho? Do people know how much water they use for various daily household activities? When asked to conserve water, would people know which behavioural changes are more effective than others? What motivates or drives people to use residential water in the way that they do and what will motive them to change the way in which they use water? Are households aware of their actual water use and do perceptions of water use correspond with actual water use?

A study by Viljoen (2015) on Cape Town's perceived residential water consumption trends found that laundry washing was the highest water use activity in the informal settlements category (hand washing) and low-income category (hand or washing machine), with 55.82% and 62.86% of respondents, respectively, reporting laundry washing as the highest water use activity. In the middle to high income category, the perceived highest water use activity shifted to showering with 46.51% of the respondents reporting showering as the highest water use activity on their properties (Viljoen, 2015). In contrast, the GreenCape Market Intelligence Reports for Water (2017), revealed a slightly different story. Actual water use data revealed that in low-income households, the highest water use activity was for flushing of toilets followed by showering or bathing. Similarly, in high-income households, there was a near equal balance between water use for flushing of toilets and showering or bathing as the highest water use activities. Given that the Viljoen study was based on *perceived* water use, and the GreenCape data on *actual* water use, it is clear that a disconnect exists between actual and perceived water use.

Water Demand Strategies and Human Behaviour

Indeed, sustainable long-term water resource management requires an integrated mix of supply and demand-side management strategies in accordance with integrated

water resources management (IWRM) principles. Yet, in South Africa the scope for supply-side management strategies is rapidly decreasing (De Lange, 2010b). The only remaining options for increasing water supply are becoming increasingly expensive and less and less feasible, such as further inter-basin transfers and desalination of seawater or treatment of acid mine drainage. The key to strategic water resource management, therefore lies in effective demand-side management approaches (De Lange, 2010b). Demand-side management refers to the use of instruments (economic, social, and regulatory) aimed at ensuring more efficient water use, and ultimately reducing water demand.

Demand-side management strategies are particularly relevant for South Africa, where a number of municipalities have implemented water restrictions to curb water use. However, many of the strategies and instruments used for changing water use behaviour have had limited success, and where they have been effective, the changes in behaviour have been temporary. In order to design and implement instruments that effect permanent reductions in water use, we first need to understand the drivers of water use behaviour, and then design demand management instruments in response to these drivers.

Worldwide, researchers have conducted several studies on the nature of household water use with a range of findings. Ungar (1994) argues that the environment is a domain in which attitudes do not predict behaviours very well. In a different vein, Sofoulis (2005) argues that socio-technical considerations influence consumption, and that these considerations do not change rapidly or evenly over time. For example, residents may not be able to change their behaviour very quickly because of the rigidities or path dependencies created by the water supply and waste disposal systems they have available to them e.g. standard waste disposal fee that provides no incentive to produce less waste or recycle (Sofoulis, 2005). These path dependencies are often reinforced by the institutional structures (and cultures established in them) created to provide the services (Randolph and Troy, 2008). Despite the existing body of research, the causal relationship between changes in water use and behavioural change is still relatively poorly understood, particularly in the South African context, hence the need for the up and coming CSIR study on residential water use and behaviour.

Current state of household water use research

Several current studies investigated the relationships between water use behaviour, attitudes towards water use and socio-demographic factors, focusing on variables such as income, education, political affiliation, household family size, type of dwelling, and home ownership (Hamilton, 1983; Berk et al., 1993, De Oliver, 1999). The results were contrasting and varied. Berk et al. (1993) reported positive relationships between income and water conservation, where De Oliver (1999) reported the opposite for income, alongside an inverse relationship between education levels and conservation. Hines et al. (1987) reported that, in general, conservation activities were normally associated with higher income groups. As Gilg and Barr (2006) point out, all these studies show that people that are liberal in their political thinking conserve more water than others, mainly because they are more educated, have smaller families, smaller properties and own their homes. While these findings may be true, they are also context-specific. Higher-income earners may for instance consume more water than lower income groups with restricted water access (Gilg and Barr, 2006; Blignaut and De Wit, 2004; Blignaut 2008).

In terms of attitudes, beliefs, and perceptions, a range of variables influence water use behaviour such as price and economic incentives (Berk et al., 1980 and Syme et al., 2000), environmental threats associated with over consumption (Baldassare and Katz, 1992; Gray and Moseley, 2005), social desirability linked to socially-acceptable water saving behaviour (Sadalla and Krull, 1995), perceived rights to unlimited water supply (Lam, 1999), and intrinsic motivations and satisfaction connected with personal enjoyment of certain environmental actions (De Young, 1996).

Taken together, these socio-demographic and psychological components provide a good basis to examine water use behaviour in South Africa. These will help policy makers provide greater focus for their decisions on implementing campaigns to encourage water saving. The reason for a particular kind and extent of "behavioural entrenchment" is a function of the social context (history and culture) of the person. Changing deeply entrenched ways of doing things takes good incentives and of course, time. The level of acceptance of each demand management intervention will need to be investigated, and the reason for good/poor acceptance will need to surveyed. By understanding what drives behaviour and what incentivises better water

conservation practices, policy-makers can institute more appropriate and targeted demand management interventions. Currently, water managers have a number of water demand options available to them and some of these options are discussed below.

Summary of key demand management interventions and their impact on residential water use behaviour and attitudes in some SA metropolitan municipalities

Upgrading of existing technologies

The dominant demand management interventions in South African metropolitan municipalities remain engineering/technical in nature and involve a combination of curtailment and efficiency measures. These include replacing old water meters with new ones. Old meters are likely not registered and replacing them provides more accurate water readings. Pressure management is yet another intervention, however, according to City of Tshwane officials it is not an effective behavioural change mechanism. This is because users do not control the pressure, it is determined for them. This intervention needs to be coupled with an awareness campaign intervention, particularly for large consumers. According to the City of Tshwane, the metro sells 80% of its water to 20% of consumers, hence the need to target this group. A pressure management intervention that extends the life cycle of a system combined with a communication intervention that makes consumers more aware of their water use would be more effective. Flow regulation to implement “water shedding” is regarded as a last resort in many metropolitan areas, and are used with caution given the resultant increase in maintenance costs and health risks.

The conundrum for metros and other water service authorities, of course, is that their business is to sell water. If the demand for water drops, their revenue decreases, which negatively influences their requisite budgets.

New technological solutions

Beyond the meter, there are opportunities for water efficiency devices and tools in households and businesses. The GreenCape Intelligence Report (2017) identifies the greatest savings and technology opportunities to be in toilet flushing, greywater reuse, and non-potable garden irrigation. GreenCape also notes other technology

applications such as water-wise gardens and landscaping along with water efficient irrigation systems; grey, rain and groundwater harvesting; trigger nozzles and automatic shut-offs for hosepipes; waterless car washers; swimming pool covers and backwash recycling systems; water-efficient washing machines and dishwashers; and low flow toilets, taps and, showers (GreenCape, 2017).

The uptake of these technologies at the residential level is greatly impacted by the market appetite for sale of such technologies. This is arguably influenced by water use behaviours and attitudes – do people see the need to buy these technologies, how readily available are they, are they considered necessary or luxury items, and has a critical mass of the population bought into the idea of having them? These questions are often neglected in technology foresight and/or uptake studies.

Figure 2. Rainwater harvesting technology option for urban areas (Source: https://www.stormsaver.com/, 2017)

Punitive measures: financial

Preliminary data collection in the City of Tshwane revealed that “one thing that works is when a guy feels it in his pocket” (pers. comm City of Tshwane official, 21 February 2017). As a result, in order to change behaviour (but not necessarily attitudes), punitive measures that result in, for example, penalty tariffs and the like, are considered to be the most effective demand management intervention to reduce residential water use. This may be linked to the prevalence of higher income groups in the city.

Punitive measures: water use restrictions

A popular intervention is to restrict water use across domestic and economic sectors in an effort to curb water usage. However, the implementation of the restrictions related to the recent drought episode of 2015/16 has not had an immediate and desired effect. The national Department of Water and Sanitation issued a notice in the Government Gazette of 12 August 2016 compelling municipalities who draw water from the Vaal Integrated Water system to reduce water consumption by 15%. While actual restrictions had started on 6 September water reduction had only reduced by 2.7% by the 3rd of October (Dhlamini, 2016). People were therefore not saving the expected volume of water despite the notice by government and a call from municipalities. The City of Tshwane instituted an intervention called *Thiba Komelelo* (Stop the Drought), which entailed a ‘stick’ approach involving technical measures to reduce supply as well as several community awareness campaigns (Meissner and Jacobs-Mata, 2016).

Conclusion

The CSIR has therefore embarked on new research into residential water use and behaviour, in which we will focus on the issue of attitudes of households to their water consumption in a search for ways in which domestic demand for water in South Africa’s urban areas may be measurably reduced. Evidence on attitudes of households in different kinds of housing and different neighbourhoods in six of the eight metropolitan municipalities in South Africa will be obtained using existing actual water use data, previous studies conducted at the municipal level, and a random quota household survey supplemented by information derived from focus groups drawn from households in the same areas. The project aims to bring to the fore the complexity of the forces shaping demand and water use in the context of the socio-demographic

composition of households in different kinds of dwellings, as well as the knowledge/awareness, cultural, behavioural and institutional aspects of consumption (i.e. the intricacies of the domestic water use profile). In so doing, it further aims to inform public policy regarding strategies and actions to reduce consumption and/or provide alternative domestic supplies of potable water i.e. the actual incentives for behavioural change.

This study therefore aims to advance our understanding of household water use and current water wise behaviour in the major South African metropolitan areas, by comparing actual household water use with perceived water use in different dwelling types (houses, flats, informal settlements) and for a variety of indoor and outdoor activities, focusing on urban households in six of the eight metropolitan municipalities. A key question is whether over- and underestimations exist for judgments of water use. The study also seeks to collate individual perceptions on the most effective water-wise behaviour, as well as the main drivers influencing behavioural change. Additionally, the three-year study aims to identify past or existing water-wise/public awareness/save water/demand management interventions implemented by a range of institutions (e.g. DWS, water boards, municipalities and notable private sector, NGO and media interventions) and assess their ability to change water use behaviour, i.e. we would identify these interventions and will determine what our respondents think of them, and how likely they are to learn from them (e.g. revisions in municipal billing; a national TV broadcasting; awareness campaign on community radio; social media; youth awareness drives; targeted campaigns in printed media community newspapers; incentive-based interventions– competition, innovation challenge, peer-to-peer learning).

Outputs of the project will include:

- a comprehensive national database that for the first time, will link detailed data on household characteristics, the characteristics of the dwellings they occupy and their water consumption behaviour and attitudes;
- an integrated social urban household water use model to illustrate household water use patterns at a national level; and

- Policy advice on required actions and strategies of national and local government, and water boards.

Should you be interested in hearing more about the development of this study and/or would like to collaborate, please contact: Dr Inga Jacobs-Mata (ijacobsmata@csir.co.za)

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