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Drivers of an urban community's acceptance of a large desalination scheme for drinking water

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SUMMARY

Changing climates and growing populations have prompted policy makers to shift to more climate resilient, technology-driven water sources, such as seawater desalination. Desalination is a prominent water resource in the Middle East but countries in other parts of the world with similar scarcity issues and good access to sea water, such as Australia, have been comparatively slow to adopt it. This paper explores attitudes to desalination in Perth, Western Australia, and the factors that influence its acceptance. We compared individuals' acceptance of desalination over two time periods by using identical surveys administered in 2007 and 2012. We then examined the attitudinal factors – attitudes towards desalination and attitudes towards the environment – that influence acceptance. Acceptance of desalination was reasonably high and stable at both times (74% and 73% in 2007 and 2012 respectively). We found that respondents' attitudes to perceived outcomes and benefits, fairness, environmental obligation and risk were important predictors of their acceptance of desalination in both surveys. However the weight given to these aspects varied over time. The findings show that there is still mixed community sentiment towards desalination, which helps to explain why acceptance has not increased since desalination was introduced in 2006.

1. Introduction

Potable domestic water supply is a resource in high demand and decreasing supply in drying climates, globally. Water supply is particularly vulnerable to the effects of climate change (Roberts et al., 2010; Hall et al., 2014). In Australia, a 17% rainfall decline has been observed in the southwest and southeast in recent decades, resulting in declining streamflow. In the far southwest, streamflow has declined by more than 50% since the mid-1970s (CSIRO and Bureau of Meteorology, 2014).

The majority of Australia's population lives in coastal regions, in cities that are predominantly dependent on dams and groundwater for potable drinking water. With the drying climate and increased water demand there is likely to be increased pressure on this diminishing resource by 2030 (McFarlane et al., 2012). The reliability of water supply is an issue that water utilities are acutely aware of. For example, in Western Australia, Perth's water utility, Water Corporation, has an objective of ensuring that the annual probability of a complete sprinkler ban is less than 0.5%, or a 1 in 200 year occurrence (Gao et al., 2014).

These cities are facing significant water supply challenges, yet the options available to protect against declining water supply are limited. Recycled wastewater is used by a few countries to supplement potable water supply. For example, in Singapore wastewater is treated and pumped directly into the potable supply system (PUB, 2014); and central Orange County, California, augments groundwater with treated wastewater (Orange County Water District, 2009). Although wastewater reuse has the potential to supply significant amounts of water into the supply system, and is climate resilient, many schemes have stalled or failed due to a lack of community acceptance, and in some cases community outrage (Gibson and Burton, 2014).

Demand management is one alternative to supply augmentation. It is considered to have clear economic and environmental

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benefits – compared to increasing water supply – and the social benefit of being equitable (Winpenny, 1997). Unlike supply augmentation, demand management does not mean water prices will increase, as there is no requirement by the water utility to build new infrastructure. Hence, lower socio-economic households are less impacted by demand management strategies. However, there is worldwide evidence that demand management strategies suffer from the rebound effect – a phenomenon in which household consumption increases after the adoption of demand management strategies because efficiency gains (from demand management) are offset by behavioural responses (to consumption). This is particularly significant in the energy sector (Greening et al., 2000) and the irrigation sector (Dumont et al., 2013). As such, demand management may not be the most reliable solution to managing the balance between water demand and supply.

Desalination, the treatment and reuse of salt water, is a climate-independent water source. There are approximately 15,000 desalination plants in operation worldwide, approximately 50% of which are located within the Middle East (Greenlee et al., 2009). Many other cities with scarcity issues and access to sea water recognise salt water desalination as a key solution to sustaining future water supply (Greenlee et al., 2009), but have been comparatively slow to adopt it. For example, the Carlsbad Seawater Desalination Project in San Diego County has been in development since 1998 and is expected to be supplying water to up to seven percent of customers by 2016 (San Diego County Water Authority, 2011). Sydney Water, in Australia, built a large scale desalination plant in Sydney to supply up to 15% of customers, but sourced no water from it in the 2013/2014 financial year (Sydney Water, 2014). In Spain, March et al. (2014) report on the large, idle capacity of desalination plants. In comparison Adelaide and Perth, in Australia, sourced 28% and 39% of potable drinking water from desalination in the same financial year (South Australian Water Corporation, 2014; Water Corporation, 2014).

Experience with introducing new technology-driven water sources suggests that community acceptance is crucial. For policy makers attempting to pursue new desalination schemes, there is little literature available on likely community reactions to guide their policy and investment decisions. We review here what little evidence is available, from a search of the international literature.

Evidence on the stated acceptance of desalination is reported by Theodori et al. (2009), Marks et al. (2008), Dolnicar and Schäfer (2009), Dolnicar et al. (2011) and King et al. (2012). In a survey of consumers in Texas, Theodori et al. (2009) found respondents were more favourably disposed towards the use of desalinated water for purposes where the probability of human or animal ingestion is lessened. This suggests that respondents perceived the quality of the water as less than pristine. In an Australian context, Marks et al. (2008) found 51% of respondents surveyed in Australia's capital cities (excluding Darwin) were willing to use desalination water for drinking. Similarly, Dolnicar and Schäfer (2009) found 49% of their sample would be likely to use desalinated water for drinking.

In the study by Dolnicar and Schäfer (2009), knowledge and perceptions of desalinated water and socio-demographic characteristics were also captured. Respondents identified environmental impacts and cost as the main issues with using desalination water. In addition, open-ended questions identified 33% of respondents that had health concerns with desalinated water, 55% said they were concerned with the greenhouse gas emissions from the desalination process, and 11% said it was an expensive option. The socio demographic profile of a strong desalination water acceptor is likely to be older, male and educated. The lower than expected acceptance rate reported (49%) may be connected with the finding that 20% of respondents had little knowledge of what desalination is and where the water is sourced from. However, as the respondents stated environmental and cost factors as concerns, these might also explain the low level of desalination acceptability.

Dolnicar et al. (2011) elicited the stated likelihood of Australians in Adelaide, Sydney, Brisbane, Melbourne, Perth, Darwin, The Mallee[1] and Toowoomba[2] using desalinated water for a wide range of household uses. They also captured a range of socio-demographic and psychological data, including respondents' knowledge and perception of desalination and pro-environmental attitudes. They found two groups with a higher stated likelihood of use – older respondents and those that had previously used desalination. The psychological factors found to be influential included positive perception, positive attitude towards conservation and the environment, influence of others and experience with water restrictions.

The King et al. (2012) study surveyed a large number of people across Australia and found that only 20% of those surveyed felt that desalination is the best solution to water shortages in Australia, 14% think it is the only solution and 72% think that other methods should be tried or considered first, before desalination. 51% were concerned about environmental issues from desalination.

Desalination is a key water source option for coastal cities in the midst of a drying climate. The aim of this paper is to (1) evaluate community acceptance of using desalination technology to supplement urban water supply, (2) identify the attitudinal factors that influence community acceptance of desalination technology, (3) comment on if and how acceptance and attitudes may have changed over time. We use the community of Perth, in Western Australia, as a case study. The timing of the surveys, 2007 and 2012, provides a unique opportunity to investigate if acceptance and attitudes changed with increased exposure to desalination over time. Our findings identify the segments in the community that have remained stable in their views of desalination and those that have changed. We provide guidance to policy makers worldwide in developing acceptable desalination operations in countries facing severe drinking water shortages, such as Australia.

2. Method

2.1. Case study area

Perth – current population just under 2 million people – is located in the south west of Australia. The region has experienced significant climatic change since 1970, most significantly, a 17% decline in average winter rainfall. Coupled with the fastest growing metropolitan area in Australia (Australian Bureau of Statistics, 2014), Perth is faced with significant pressure on its existing water sources. Previously, surface water was the dominant potable supply for Perth, followed by groundwater. The Gnangara Groundwater System provides over 50% of all water used in the greater Perth–Peel region. Meeting the growing demands on groundwater will likely require new supply sources, amongst other measures such as demand management (Gao et al., 2013) and promoting the installation of household rainwater tanks (Zhang et al., 2015).

Like the majority of population centres in Australia, Perth is a coastal community, giving it access to a suitable source of feed water for desalination plants. Desalination has featured as a key part of the Water Corporation strategic water supply plan since the first desalination plant started producing drinking water for residents in November 2006. Currently 39% of all Perth's potable water comes from two desalination plants, the most of any Australian city (Water Corporation, 2014). The Water

[1] The Mallee region is located in the North East of the State of Victoria, Australia.
[2] Toowoomba is a town located in South East Queensland, Australia.