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Predictors of local support for a seawater desalination plant in a small coastal community

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ABSTRACT

Seawater desalination is increasingly being pursued to address freshwater shortages. In California, multiple coastal seawater desalination facilities have been proposed to diversify water portfolios and to increase reliability of water supply. This paper explores local residents support for a newly constructed desalination plant in Carlsbad, a small coastal community in Southern California. The plant is the first high-capacity desalination facility in California and started operation in December 2015. We found strong support for the desalination plant as 71.9% of residents reported support for the plant. Only 15.5% of respondents were undecided indicating that residents had a clear opinion on the plant. Perceptions about local water resources were significant predictors of support. Attitudes may change over time if the state of water resources and perceptions thereof change. Expected outcomes of the plant also predicted support. An increase in available drinking water was a positive predictor, while environmental and social impacts were negative predictors. Economic impacts in terms of an increase in the price of water did not influence local support. Ethnicity and age were the only socio-demographic variables that had an effect on support suggesting that the socio-demographic profile of a community may not be a good predictor of community support or rejection of this water supply technology.

1. Introduction

Freshwater accounts for only 2.5% of the total volume of water on earth (Oki and Kanae, 2006; World Water Assessment Programme, 2009). Many regions worldwide are experiencing freshwater shortage due to increasing water consumption and environmental changes that are reducing the reliability of traditional water resources such as surface and groundwater sources (Bourne, 2008; Dolnicar and Schäfer, 2009; Seller, 2008). In response, water agencies have started to adopt measure to reduce demand for water (e.g., water conservation measures) (Martin, 2015) and to increase water supply by pursuing new technologies including seawater desalination. Seawater desalination is particularly valued for the production of high quality drinking water, for being independent of climate and for providing a reliable source of water during droughts. The sector is growing and more than 17,000 desalination plants were in operation worldwide in 2013 with a global desalination capacity of more than 80 million cubic meters per day (International Desalination Association, 2014).

In the US, seawater desalination is an emerging ocean sector with potential for growth in the future. Freshwater supplies in coastal areas relying on imported and groundwater sources have become increasingly unreliable with changing weather patterns, recurring droughts, and saltwater intrusion into aquifers due to low groundwater levels that could be aggravated by rising sea levels (Bourne, 2008; Heberger et al., 2009; Mirchi et al., 2013; Sellers, 2008). Water authorities are subsequently seeking to diversify coastal water portfolios with seawater desalination. The technology is expected to reduce dependence on imported water and underground aquifers in coastal areas, and to help satisfy increasing demand for drinking water due to growth in coastal population and industries (California Coastal Commission, 2004; Monterey Bay National Marine Sanctuary and National Marine Fisheries Service, 2010; Peel and Choy, 2014; State of California Public Utilities Commission, 2015).

Desalination development, however, remains controversial due to potential environmental economic, and societal impacts (Cooley

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et al., 2013; Fuentes-Bargues, 2014; Liu et al., 2013). Seawater desalination is a relatively expensive technology that increases the water price for consumers (Cooley and Heberger, 2013; Côté et al., 2005; Dawoud, 2005; Hinkebein and Price, 2005; Schiffler, 2004). The development of desalination plants can also reduce public access to coastal areas, disrupt coastal recreation activities, and alter aesthetics of the coastal landscape (California Department of Water Resources, 2003; Liu et al., 2013; Sellers, 2008).

Environmental impacts of desalination plants compare to some extent to impacts of other coastal developments (e.g. land use change) (Lattemann and Höpner, 2008). Effects more specific to desalination are consequences of the intake of large quantities of water and brine discharge, including mortality of larvae and other organisms due to impingement and entrainment during seawater intake. Brine discharge can lead to degradation of marine habitats, impacts on marine life on the ocean floor, coastal eutrophication, and changes in seawater quality, in addition to changes in coastal hydrology during construction (e.g., Elimelech and Phillip, 2011; Lattemann and Höpner, 2008; Roberts et al., 2010; Sanchez-Lizaso et al., 2008). Indirect impacts such as ocean acidification and sea level rise may also result from increasing greenhouse gas emissions from the relatively high energy consumption of operating seawater desalination plants (Cooley and Heberger, 2013; Miller et al., 2015). Specifically, as nearshore areas can be important habitat and spawning areas, both intake and brine discharge add further stress to marine environments already affected by a variety of anthropogenic activities (Halpern et al., 2008).

Another consideration for seawater desalination plants are their effects on marine protected areas that are increasingly being established all around the world. One example in the US is the newly created Marine Protected Area (MPA) network along the coast of California. This network is the first of its kind in the US and consists of 124 MPAs intended to safeguard the productivity and diversity of marine life and habitats in coastal California for current and future generations (Natural Resources Defense Council, 2014). Seawater intake and brine discharge from desalination plants built in close proximity to MPAs could have impacts on protected values within individual MPA sites. Reduction of larval connectivity between MPAs, due to entrainment and impingement in the intake pipes of desalination facilities, might further compromise the effectiveness of the broader MPA network (Natural Resources Defense Council, 2014). While a number of studies have suggested that changes in marine ecosystems resulting from desalination activities might also lead to impacts on recreational and commercial marine users (Liu et al., 2013; Monterey Bay National Marine Sanctuary and National Marine Fisheries Service, 2010), these impacts have not been systematically studied to date.

1.1. Public perception of seawater desalination

Development of seawater desalination plants in the US has been slow so far. Changes in regulations (e.g., State Water Resources Control Board, 2014) and opposition of environmental groups and coastal residents have slowed down the development of proposed new plants (e.g., Desal Alternatives, 2013; Pasko, 2013). Even though community acceptance can be critical for the implementation of desalination plants, little is known about community reactions to desalination plants and the variables that influence attitudes towards this water supply option.

Previous studies on attitudes towards water schemes, such as desalination, fall into three categories. The first include studies on general attitudes towards a water supply option by asking the public wide ranging questions that are not attached to a specific project. The second are studies focusing on public opinions on actual forthcoming water projects, and the third researches attitudes in locations where a new water supply scheme has already been put in place (Friedler et al., 2006).

Compared to water conservation (e.g. Tortajada and Joshi, 2013) and alternative water schemes such as water recycling (e.g., Ching, 2016; Hartley, 2006; Bridgeman, 2004), literature on attitudes towards seawater desalination is still very limited. Most previous studies on desalination fall into the first category and examine general attitudes towards seawater desalination as a water supply option (King et al., 2012) and acceptance of using desalinated water (e.g., Dolnicar et al., 2011, 2010; Dolnicar and Schäfer, 2009; Theodori et al., 2009). These studies have been informed to a great extent by theoretical approaches in social psychology and psychological risk perception literature (e.g., Ajzen and Fishbein, 1988; Pidgeon and Beattie, 1998). The main concerns with using desalinated water were perceived environmental impacts, costs, quality of desalinated water and associated health concerns. Acceptance was also influenced by socio-economic variables including education, age, and gender. Acceptors of desalinated water were older, male, educated, and had previously used desalinated water. Psychological factors that shaped acceptance of using desalinated water included positive attitude towards conservation and the environment, and social norms (Dolnicar et al., 2011; Dolnicar and Schäfer, 2009). Environmental concerns also lowered public preference for desalination as an alternative water supply in Spain (Domènech et al., 2013) and Australia (King et al., 2012).

Studies on actual or forthcoming projects are even more limited. One study by Gibson et al. (2015) explored public acceptance of expanding desalination in Perth, Australia. The authors compared the influence of attitudinal and socio-demographic factors on public voting behavior for or against additional desalination plants in Perth in 2007 and 2012 and found support for the expansion of desalination in both years (74.5% in 2007 and 73.4% in 2012) but the drivers of acceptance changed over time.

Our work builds on existing studies and explores public support for a newly established desalination plant in a small coastal community in Southern California. In contrast to studies on general acceptance of seawater desalination (King et al., 2012), of using desalinated water (e.g. Dolnicar and Schäfer, 2009), or support for future projects (Gibson et al., 2015), we investigate local support for a local desalination project that has recently been completed. Understanding attitudes towards a particular project is crucial for the siting of new plants. Even if the wider consumer constituency is in favor of desalination, individual communities may oppose a project in their area, which can lead to significant delays or even abandonment of water supply projects (Hurlimann and Dolnicar, 2010; Mainali et al., 2011; Pierce, 2013). Assessing local residents' views on plants within their community is critical for understanding why communities support or oppose these projects.

The aims of the paper are to (1) assess local perceptions of water resources and outcomes of the newly built desalination facility; (2) evaluate local support for the plant; (3) identify variables that shape and predict local support. We explore whether the socio-demographic profile of a community affects local support as previous studies reported significant relationships between socio-demographic variables and attitudes towards proposed desalination plants (Gibson et al., 2015) and acceptance of using desalinated water (Dolnicar and Schäfer, 2009). We also investigate whether frequent use of local marine areas affects support since a number of studies have suggested that impacts on marine ecosystems from desalination might lead to impacts on recreational and commercial marine users and create conflicts with existing activities (Liu et al., 2013; Monterey Bay National Marine Sanctuary and National Marine Fisheries Service, 2010).

Our study further investigates whether the design of the plant and the environmental context shapes local acceptance. Most