Desalination 397 (2016) 1–8

Contents lists available at ScienceDirect

Desalination

journal homepage: www.elsevier.com/locate/desal

Trust matters: Why augmenting water supplies via desalination may not overcome perceptual water scarcity

Maria Christina Fragkou [a,*], Jamie McEvoy [b]

[a] Department of Geography, Faculty of Architecture and Urbanism, Universidad de Chile, Portugal 84, Santiago, Chile
[b] Department of Earth Sciences, Montana State University, 226 Traphagen Hall, Bozeman, MT, USA

HIGHLIGHTS

• The production of desalinated water is examined from a social studies perspective.
• We combine literature on water scarcity, risk and water quality perception.
• A comparative case study of two Latin American cities served by desalination plants.
• Results reveal that consumers prefer bottled to desalinated tap water for drinking.
• Trust in water companies and traumatic experiences influence consumer preference.

ARTICLE INFO

Article history:
Received 12 February 2016
Received in revised form 16 May 2016
Accepted 11 June 2016
Available online xxxx

Keywords:
Desalination
Bottled water
Water scarcity
Trust
Latin America

ABSTRACT

Historically, water scarcity has been understood to result from unfavorable climatological and hydrological factors. From this perspective, infrastructural solutions that augment water supplies, such as desalination, are seen as the way to overcome physical resource limits and resolve water scarcity. Drawing on theories of scarcity, risk perception, trust, and governance, we argue that past experiences with poor water quality and a long-standing mistrust of water providers create a particular mode of water scarcity: perceptual scarcity. This paper presents findings from household surveys conducted in two arid Latin American cities where large-scale desalination projects have been undertaken to provide potable water. While both projects use state-of-the-art desalination technology, our survey results indicate that the majority of respondents do not drink desalinated water from their taps and purchase bottled water instead. Our results show that, despite significant investments in infrastructure, respondents still lack an adequate supply of water that is perceived to be fit for human consumption. The two case studies provide empirical evidence that challenges the assumption that desalination technology will resolve water quality and water scarcity concerns. We conclude that institutional investments that promote a more reliable and trustworthy water governance system are as important as investments in physical infrastructure.

1. Introduction

Desalination – the process of converting saline water into freshwater through the removal of dissolved minerals – is increasingly viewed as a panacea to water scarcity. Under predictions of global decrease of available renewable water resources per capita [37,68], the capacity to produce desalinated water has grown rapidly in the last decade, principally in coastal arid areas. For the period between 2008 and 2013, the installed capacity has increased annually by a rate of 57%, resulting in the installed capacity of 80 million m^3/day for 2013, provided by 17.000 plants, serving over 300 million people [33]. Due to improvements in membrane technology and energy recovery systems, the costs of desalination have been reduced by 50% in the last decade, making it a more attractive alternative [46]. This technology promises to overcome problems of low water availability and poor water quality in arid and semiarid regions where latent and existing conflicts over water allocation exist [60]. Desalinated water is promoted not only as an additional source of freshwater, but as a quality-controlled, premium form of "produced water" that is free of contaminants. Additionally, it can be viewed as a "green" technology where the use of desalinated water has the potential to reduce pressure on freshwater resources and allow more water for ecological flows [11,39]. In Spain, for example, desalination was promoted as a "…local, democratic, market efficient and ecologically sustainable" solution, when compared to the controversial solutions to scarcity such as inter-basin water transfers and

* Corresponding author.
E-mail address: mariac.fragkou@gmail.com (M.C. Fragkou).

http://dx.doi.org/10.1016/j.desal.2016.06.007

river diversions [34]. On a more conceptual level, seawater is also free of the complex property rights and social, cultural and ecological meanings that are associated terrestrial waters and can lead to geopolitical conflicts [60].

Nevertheless, our results reveal that in two Latin American case studies, desalinated water does not meet consumers' most basic need.[1] Our survey results show that consumers of desalinated water do not use it for drinking. Instead, survey respondents purchase bottled water to meet their households' drinking water needs. We argue that this preference for bottled water stems from previous experiences with poor water quality and a long-standing mistrust of water providers and government services.

In this paper, we apply theoretical concepts and survey methods from the social sciences to research on desalination – a field which, to-date, has focused primarily on the technical aspects of this technology. In doing so, we provide empirical evidence which challenges the assumption that a state-of-the-art technical solution to water provision will address water quality (and water scarcity) concerns. These findings contribute new insights to the ongoing discussion of different ways of conceptualizing water scarcity by examining the role of risk perception and the production of perceptual scarcity. It also adds a new dimension to the growing body of literature on bottled water consumption by providing empirical results from household surveys on preferences for tap water versus desalinated water. These findings suggest that there is a need for more robust assessments of solutions to water scarcity that include investments in not only infrastructure, but also in institutional capacity building among water providers to re-establish the trust of water users.

In what follows, we begin with a review of the literature on water scarcity, risk perception, and bottled water. We then present our methods and the Latin American case studies. The results section presents the most relevant findings from both cases. We conclude with a discussion about the importance of investing in not only infrastructure, but also in reliable and trustworthy governance institutions.

2. Literature review

2.1. Water scarcity: challenging an evident concept

Concerns about global water availability and its impacts have been expressed during the last decades under the alarming terms of "global water crisis" [8], global "water scarcity" [64], or even "water wars" [55], when referring to the struggles around the allocation of this resource. The majority of related studies are usually limited to volumetric accountings of water reserves with the use of physical indicators that measure water availability or water scarcity [51]. Falkenmark's popular indicator is based on a calculation of the per capita water demand as a fraction of the total water available for human use [19,20]. From this perspective, a lack of water is what causes water scarcity and engineering and infrastructural projects that augment water supplies have historically been prescribed as the solution for overcoming water scarcity. However, these quantitative representations of water availability are simplistic and fail to analyze the socio-political causes and implications of water scarcity [43]. Moreover, such approaches tend to present water scarcity as a solely natural phenomenon, obscuring its complexity and "…its linkage to ecological, socio-political, temporal and anthropogenic dimensions" [42]. In this sense, there is a general acknowledgement of the distinction between water shortages – referring to a physical deficit of water – and socially constructed water scarcity – as a result of changing lifestyles, growing population and economic sectors fighting over limited water resources [43].

Various frameworks have been developed to classify different types of water scarcity. For example, Wolfe and Brooks [65]) describe a three-part classification system based on drivers of and responses to water scarcity. According to this classification system, first order scarcity is caused primarily by low levels of precipitation and water availability; solutions focus on supply-side engineering solutions such as dams, wells, and desalination. Second order scarcity is a result of inadequate infrastructure and/or poor management; responses focus on demand-side water management tools to ensure the efficient use of water. Third order responses are caused by deeply entrenched cultural and institutional norms that have produced our current patterns of water use and shape the way we value water; responses require a radical reassessment of social values, lifestyles, and water user patterns.

Mehta [44]) introduces a "human development approach" to water scarcity classification, which emphasizes the political nature of water scarcity and highlights access and control over water resources as key determinants of water scarcity. She argues that, "scarcity is not 'natural' but generated through socio-political processes, through exclusion, biases, and discrimination." (p. 61). Therefore, this approach analyzes how social and political institutions, cultural norms, and property rights shape individual's access to water, giving special attention to how social variables such as race, class, and gender affect resource access.[2]

Robbins et al. [52]) provide a three-part classification of water scarcity. According to this framework, "hydrological scarcity" results from a combination of climate, affluence, and human population (e.g., in oil-rich Gulf States). "Techno-economic scarcity" results from conditions of underdevelopment and a lack of financial investments in infrastructure and technology meet growing water demands. This type of scarcity is particularly acute in rapidly urbanizing cities where water distribution systems are not able to keep pace with urban sprawl. While these first two categories are similar to Wolfe and Brooks [65]) first and second order scarcity, Robbins et al. introduce a unique third driver of scarcity, which they call "perceptual scarcity." This refers to contexts where water treatment is widespread, but there is perception that bottled water is safer (pg. 269).

2.2. Trust matters: the production of perceptual scarcity and bottled water consumption

To better understand perceptual scarcity, we draw on risk perception research, which shows that trust is an important factor that shapes the public's acceptance or rejection of new technologies. Risk perception research has roots in the fields of geography, psychology, anthropology, and sociology. One of the aims of this research is to understand how people gauge the severity of different natural hazards and technological risks (e.g., drought, floods, nuclear power, or genetically modified foods). A key question within the field is: why do experts and lay people (i.e. the public) often have different perceptions of risk? (see reviews by [56,58]).

Early risk perception theories assumed that the public tended to over- or underestimate the degree of risk due to ignorance. Researchers assumed that by developing educational material and informing the public about a controversial risk management issue, the publics' opinion would align with expert judgment [58]. This approach has been criticized for ignoring the psychological, social, and cultural factors that shape people's perceptions of risk [16,17,56,59]. Several studies have shown that trust is an important social value that shapes risk perception [48,49,59]. Slovic [59]) argues that risk management has become increasingly "contentious" and "polarized" due to an erosion of trust in the "individuals, industries and institutions responsible for risk management" (p. 675). He argues that trust is "asymmetrical" meaning that it is easy to destroy and hard to rebuild:

[1] These findings are not generalizable to other communities that use desalinated water to augment drinking water supplies. Additional research is needed to assess consumer preferences in a variety of institutional and geographical settings.

[2] The history of water infrastructure development is rife with examples of supply-side engineering solutions (e.g., dams, canals, and irrigation infrastructure) that failed to meet the needs of the poorest and most marginalized citizens (see for example [50,66], or [67]).