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Review

Review of socio-economic drivers of community acceptance and adoption of decentralised water systems

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ABSTRACT

The aim of this paper is to highlight key social and economic drivers crucial to understanding community acceptance and adoption of decentralised water systems. The review focused on social science literature pertaining to alternative forms of household water, with an emphasis on research examining decentralised water acceptance. Researchers consistently reported that most communities were open to alternative water sources for domestic applications; however, this was highly dependent upon the level of personal contact with the water. Acceptance and adoption of alternative water technology, such as decentralised systems, was influenced by risk perception, water culture, and threat perception. Motivational drivers were also identified as potentially influencing adoption of decentralised systems. A clear limitation of the literature was found to be an over-reliance on measuring people's intentions to adopt alternative water systems and building a conceptual understanding of acceptance solely on hypothetical water supply scenarios. Further, within the social science literature there appears to be a skewing towards focusing on acceptance of centralised alternative water, such as recycled and desalinated water systems. Although there are some research outcomes that are generalisable to the decentralised water context, it is clear that there is a significant gap in the knowledge base of social drivers specific to the acceptance of decentralised water systems and the factors contributing to its widespread use. It is recommended that future research focus on examining public attitudes relevant to decentralised water systems, as well as adoption behaviours among current users of these systems. This will assist in developing policies specific to domestic decentralised water use.

1. Introduction

Competing global demands on water, such as irrigated agriculture, climate change, and population growth, mean that there is an increasing pressure on existing water resources to satisfy a demand that is approaching the limit of supply. Water reuse strategies are currently being researched, developed and implemented among various communities around the world, to determine whether alternative water supply systems are technologically viable, economically feasible, as well as socially acceptable within an urban context (e.g., Jones et al., 2006; Massoud et al., 2009). Many regions worldwide are facing sustainability concerns and are turning to alternative water technologies to combat their impending water supply issues. In developed countries such as Germany and Japan, local governments are addressing water crises by building greater water infrastructure around centralised recycled water treatment systems as well as encouraging household-level installations to harvest water (e.g., Asano et al., 1996; Nolde, 2007). In emerging regions, such as southern Brazil and central Africa, where costly development on a national scale is not feasible, on-site water storage and reuse systems are the most functional options and are being tested and implemented for potential potable applications (e.g., Ghisi & de Oliveira, 2007; Mwenge Kahinda et al., 2007).

An example of a region with significant water sustainability issues is Australia. Australia is considered the driest inhabited continent on Earth, with the majority of land comprising desert or semi-desert areas that are unsuitable for agriculture. Consequently, over 85% of the population resides within the urban centres and this trend is strengthening (The World Bank, 2010). Australia has been identified as a high stress region, where human freshwater consumption in many urban areas has increased beyond the capacity of supply (Bates et al., 2008; Dolnicar and Schäfer, 2009). Brisbane, the capital city of Queensland, is situated in the south east of the state and has a projected 50-year growth rate of 114% according to the Australian Bureau of Statistics (ABS, 2008), which

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makes it the second fastest growing city among the Australian capitals. Consequently, Queensland has developed a long-term water strategy designed to cope with this greater urbanisation, which focuses on increased water infrastructure at the household level, as well as large-scale recycled and desalinated water options (QWC, 2010). Water sustainability issues, however, are not limited to South East Queensland (SEQ). Government reports and scientific findings suggest that if significant investments are not made in adopting alternative sources and practices, regions such as SEQ and other highly populated urban areas within Australia are likely to face serious problems associated with maintaining adequate water supplies that are both environmentally and financially sustainable (Coombes and Kuczera, 2002; Russell and Hampton, 2006).

Overall, the use of greywater and rainwater harvesting systems as on-site potable and non-potable water supplies is gathering momentum in many countries that experience periods of high, but inconsistent, rainfall and experience unsustainable consumption due to hydrologic and populous reasons (e.g., India, China). Countries are beginning to legislate water conservation measures and starting to incorporate the construction of decentralised systems into local development standards and building codes (e.g., DPI, 2010). Therefore, it is becoming apparent that on-site systems can be of critical importance in addressing the global issue of sustainable water use because of their ability to provide water to individual homes, small groups of houses, and large-scale housing developments in a simple and economically feasible way (Cook et al., 2009). However, the use of these systems is also directly influenced by community attitudes due to the immediacy of responsibility in managing decentralised water supplies. Furthermore, given that most regions affected by water sustainability issues are highly urbanised, the need to understand factors influencing community acceptance and adoption of alternative water systems is crucial to the successful implementation of these strategies. That is, although developed countries may have the funding to improve water infrastructure, there is no guarantee that the general public will willingly accept or adopt it. Unfortunately, very little is known about the social and psychological drivers facilitating and hindering social acceptance of on-site water systems.

The purpose of this paper, therefore, is to examine empirical literature that has focused on drivers of community acceptance and adoption of various alternative water systems. In doing so, we aim to identify key social and economic drivers that may be relevant to the acceptance of decentralised (on-site) water at various scales, an area that has not been the focus of much social research. To identify relevant literature, databases were extensively searched using key terms, not limited to: decentralised water, rainwater, alternative water, social acceptance, public acceptance, community perceptions, attitudes to water and willingness to pay. The databases searched included: 1) PsychInfo, 2) Web of Knowledge, 3) Cambridge Scientific Abstracts, 4) Google Scholar and 5) InfoSearch, a tool which enables a search across various other databases. Journals were included from water science, social science, urban planning and environmental science. While the authors acknowledge this may not be an exhaustive list, the research studies identified have been used in a 'snowball' search for additional publications relative to decentralised water acceptance and adoption.

2. Alternative water sources

2.1. Definitions

Conventional town water supply systems are characterised by the collection and distribution of water acquired from protected catchments (e.g., reservoirs, dams). These systems are deemed to be centralised because all municipal water is sourced from this primary location via "mains" water pipes (Cook et al., 2009). In addition to this centralised water source, the public may also have access to two types of *alternative* water sources for their homes and businesses: *centralised* and *decentralised*. *Centralised* alternative water supplies refer to systems that are not linked to the town's main water supply, but work on the same premise as a centralised system. That is, houses have plumbed pipes connecting to the water system, which itself is located away from the point of use. A common example of this type of supply is treated recycled water from a water reclamation plant. In this scenario, dwellings may have a dual-pipe system with one set of pipes connecting to mains water inside the house and a second set of pipes connecting to the recycled water supply outside the house.

Decentralised alternative water supplies, on the other hand, are defined by Cook et al. (2009) as the collection, treatment and use of rainwater, stormwater runoff, greywater and black water. What typically differentiates decentralised water from centralised forms of alternative water is that decentralised water is sourced on-site, or close to, the point of use. These systems can be implemented at various scales, such as the allotment level (owned and usually operated by the home owner), cluster level (e.g., small-medium housing development where ownership is shared), or a distributed level where the system may service a very large housing development and is owned/operated by a water utility (Cook et al., 2009). Examples of these systems can be found in Table 1.

It is important to distinguish between conventional and alternative water supplies because each has a different social history with regards to urban use and consequently, each will be influenced by different socio-economic factors. Similarly, distinguishing between centralised and decentralised water systems is relevant because some systems may differ in terms of the water's origin and treatment, This may mean that there are varying levels of personal contact with the water source and differing maintenance requirements (e.g., self-maintained versus utility-maintained), both of which are likely to elicit differing community perceptions of social responsibility to use the water.

2.2. The use of decentralised systems in urban households

Although decentralised systems have been used worldwide, the types of technologies being adopted depend on the local context and the reasons driving the need for these systems (Tjandraatmadja et al., 2008). In parts of Europe (e.g., Germany, Sweden, Finland), pollution has negatively impacted lakes and river ecosystems, thus authorities,

Table 1
Examples of different water supplies, categorised based on centralised and decentralised distribution.

Conventional urban water supplies (potable)	Alternative urban water systems (potable and non-potable)	
Centralised	Centralised	Decentralised
•Surface water (dams, weirs and protected freshwater catchments) •Groundwater aquifer	• Treated non-potable recycled water • Desalinated seawater • Long-distance pipelines or imported water • Stormwater harvesting	• Rainwater tanks (for outdoor and indoor use) • Stormwater harvesting • Non-potable greywater systems (treated and untreated, for outdoor and indoor use) • Groundwater bores