Sustainable Water Demand Management: A Case Study of Singapore’s Accommodation Sector

Xiao Hu1*

1 International College, Kirk University, Bangkok, 10220, Thailand
Thanon Ram Intra, Khwaeng Anusawari, Khet Bang Khen, Krung Thep, Maha Nakhon10220, Thailand.

*e-mail: Hu.Xiao@staff.krirk.ac.th

Abstract. A wide variety of tourist activities rely on natural resources. One such prominent resource is water, which is not only fundamental for scenic beauty of a landscape, but is also required for promoting and sustaining accommodation environments and water is fast-becoming a scarce natural resource. This study focused sustainable water management and tourism development in the context of accommodation sector, with special attention to the water demand management (WDM) strategies and practices of Singapore - a water-stressed country and a prime tourist destination in the Asia Pacific region. This study found that there exists a water conflict between greater demand for water resource and sustainable tourism development. Singapore’s demand for water far exceeds its naturally occurring supply as the densely populated city-state has no freshwater lakes or aquifers. Management of water demand is necessary to ease this problem. Both pricing and non-pricing mechanisms to control water demand in the accommodation sector were found based on the content analysis, which reflect sustainability principles at tourist destinations. The price mechanisms refer to the potable water pricing structure. Non-pricing mechanisms, such as regulatory mechanisms, engineering instruments and alternate sources of water, as well as public education and community involvement, also play critical roles in the accommodation sector. This holistic approach to managing water resource from a demand perspective requires the support and participation from policy stakeholders from the public, private, and third sectors.

1. Introduction
Tourism, the world’s largest single industry, is often described as an intense consumer of water [1]. The availability of potable water to meet competing demands will significantly affect the tourism industry [2]. Consequently, the confluence of a growing industry concomitant with water shortage could lead to a critical situation without comprehensive water management strategies [3]. Tourism-related activities that remove water from the local supply [4]. Diversification of tourist products and development of quality tourism and hotel complexes, such as golf courses, agrotourism, gardens, swimming pools, and health spas, tend to create...
huge water demand [5]. Furthermore, freshwater withdrawn from rivers, lakes, and aquifers eventually affects water quality as a result of wastewater and sewage disposal into natural waterways [6]. This particular aspect is essentially related to this research as water demand management (WDM) measures are aimed at substantial reduction of the consumptive demand of freshwater. The accommodation sector, in particular, deserves a systematic and detailed investigation because that is one of the tourism industry’s largest drivers of employment and economic revenue and a critical water consumer in tourism [7].

2. Water management in the accommodation sector

Conventionally, water has been taken for granted as a low-cost renewable resource [8]. Hence, tourism and many other economic sectors arguably fail to protect the environmental and natural asset on which they fundamentally rely [9]. However, some believe that well planned and administered water management approaches, which require actions by all stakeholders, can potentially ease the problem of water stress and contribute to economic prosperity and social development [10]. Two broad categories of polices have been advocated for regarding managing water resources in the accommodation sector: either supply-side policies, which are aimed at increasing freshwater provisions [11], or demand-side policies which manage consumptive demand itself to postpone or avoid the need to develop new potable water resources [12]. Whilst both supply-side and demand-side policies have often been pursued concurrently [11], the relative emphasis on the latter has been observed in increasingly more destinations largely owing to environmental, social, economic, and technological considerations. Increasingly, demand-side management of water resources is viewed as an efficient system that involves stakeholder engagement [14]. Nevertheless, research priority on water management within a tourism context is still relatively low compared to residential, industrial, and agricultural water uses [15].

3. Research context - current situation in Singapore

3.1 Geographic features of Singapore

The Republic of Singapore, a diamond-shaped main island together with more than 60 surrounding smaller islands, is approximately 130 km north of the equator [16] (Figure 1). Owing to its geographical location, Singapore has a tropical climate with consistently high temperatures and humidity [17]. Unfortunately, Singapore has a finite land area and unfavourable topography to catch and store the abundant rainfall [18]. Further, this island city-state has no freshwater lakes or groundwater resources [19]. Given its hydrological conditions, the World Resources Institute (WRI) notes that Singapore will face extremely high water stress over the next decades because of the competition for and depletion of local freshwater [20]. Hence, water has been taken as a matter of national security in Singapore [21] as the demand for water over there far exceeds its naturally occurring supply [14].

3.2 Tourism Development in Singapore
In spite of water challenges, Singapore is one of the top tourist destinations on a global scale as well as in the Asia Pacific region [23]. The tourism industry in Singapore saw over 15 million annual international visitor arrivals in six consecutive years (i.e. 2013–2018) (Figure 2). Meanwhile, accommodation is one of the largest components in tourism, which shares no less than 20% of the overall tourism receipts [24]. Nearly half of international visitors to Singapore stay at commercial accommodation with an average of 3.5 tourism nights for typical overnight visitors [25]. Thus, over 25 million annual guest nights were observed respectively from 2011 to 2018.

While the accommodation sector’s economic benefits to local communities and the country as a whole have often been the subject of public attention, its social and environmental impacts have not received the same levels of attention [27]. When compared with industrial and other commercial sectors, the impacts of the accommodation development have been subject to much less interest from policy stakeholders [28]. Accommodation developments can hasten the development of much-needed utilities and infrastructure. But poor location, design, engineering and construction of accommodation buildings can adversely affect the public amenity by degrading or restricting access to natural resources (e.g. water) which the local residents rely on [29].

4. Managing water demand in the accommodation sector

Based on the circumstances of the small island destination, various policy efforts have been aimed at tourism-related WDM in Singapore regarding both pricing and non-pricing mechanisms to control water demand in the accommodation sector. Non-pricing mechanisms such as regulatory mechanisms, engineering instruments, and alternate sources of water, as well as public education and community involvement, play significant roles in the accommodation sector. The price mechanism refers to potable water pricing structure [13]. The holistic approach to managing water resource from a demand perspective requires the support and participation from the public, private, and third sector [21].

4.1 Management and regulatory solutions

Demand zone management and some mandatory requirements are a common approach to WDM in Singapore’s commercial accommodation. Punitive measures, such as financial penalties and court prosecution, can be imposed for non-compliance to discourage misusing and wasting water [30]. Registration of water products and water services is mandatory in Singapore. The regulatory instruments contain authoritative guidance on the design, installation, fixing and testing of potable water service installations in accommodation buildings or premises. Key Performance Indicators (KPIs) from which benchmarks for water efficiency in accommodation environments are commonly employed, help improve water efficiency and encourage the sustainable use of water within accommodation buildings [31].
water consumers, such as accommodation entities, water supply applications with anticipated potable requirements exceeding certain amount (i.e. 60,000 m³ per year) are submitted to PUB for approval [32].

4.2 Technical and engineering solutions

Cost-effective technical or engineering solutions, independent of the behaviour of individual tourists and accommodation management, are available in Singapore. More durable and corrosion-resistant piping materials, for instance, can help minimise the occurrence of unaccounted-for-water (UFW) (i.e. water leakage) in accommodation premises[33]. In addition, optimised water pressure with pressure-reducing valves, in the network tends to increase the durability and lifespan of the pipes thus minimising water leakage [21]. Following this, electro-magnetic flow meters help actively and accurately detect any water leaks at key water usage areas (e.g. guestrooms, restaurants, and kitchens). Water efficient landscaping, where applicable, can also potentially save a large amount of water for an accommodation building. For instance, drip irrigation, which is applied directly to the root, minimises evaporation and runoff. It reduces the amount of water used in sprinkler irrigation by between 30% and 50% [31].

4.3 Social education and involvement

The importance of water consumers’ efforts is well recognised thus various demand management initiatives have been introduced and promoted in Singapore. Commercial accommodation buildings are motivated to work towards saving 10% of their monthly water use, thereby helping them save on their water bill [18]. Water use related environmentally sustainable initiatives that cover accommodation entities, such as certification schemes, eco-labels and awards, have increased greatly since the 2000s. The Capability Development Grant (CDG) and Water Efficiency Fund (WEF) are granted to businesses, including the accommodation sector, to support their water efficiency management systems[18].

4.4 Alternate sources of water for non-potable purposes

On-site greywater recycling systems enable accommodation buildings to reuse treated greywater after the greywater has gone through treatment such as membrane filtration and disinfection to render the treated greywater safe for non-potable use [34]. Rainwater harvesting and utilisation is also a part of Singapore’s sustainable water design strategy to mitigate water shortages due to the humid climate [35]. Collected condensate water is a great source of ‘free water’ generated by its air handler and fan coil units[36]. Seawater, as another unconventional source of water, has been given serious consideration by policymakers in Singapore. Amid concern about the freshwater shortage, accommodation buildings have been encouraged to use seawater. Seawater offers an unlimited and stable water resource for toilet flushing, cooling, and process purposes [37].

4.5 Water pricing strategies

The volumetric water tariff and increasing block tariff (IBT), as two common pricing instruments, are used for managing water demand [38]. Singapore has the highest water price in South-East Asia [13]. All water consumers, including the accommodation sector, are required to be metered and charged accordingly in Singapore. The volumetric tariff is applied to businesses (including the accommodation sector), whereas IBT is employed for the household sector (Table 1). The underlying principles essentially rely on strategic importance and the scarcity value of water while also balancing affordability, conservation, and sustainability [39].

Table 1. Potable Water Pricing in Singapore
5. Conclusions

This paper has discussed the complex interplay of physical and socio-economic factors of Singapore to map out the specific local context in which water policymaking operates. For the past decade, the travel and tourism industry has generated significant economic benefits in Singapore. The accommodation sector has been playing a crucial role in Singapore’s prosperous tourism industry. The rapid development of tourism, together with industrialisation and fast population growth, has inevitably led to greater demand for water resource. Given the geographic challenges to Singapore, continuous attention and effort have been taken to ensure a good balance between tourism development and water sustainability. Long-term sustainability in water cannot be achieved by boosting water supply alone. Instead, demand management is of the utmost importance in a small coastal city-state where very limited freshwater is available [41]. Thereby, use charges together with specific taxes and/or fees have been applied to Singapore’s accommodation sector regarding the use of potable water. In parallel to water pricing strategies, which could play an incentive role, numerous non-pricing policies have been adapted for the sustainable use of water resources in the accommodation sector. Policy development on the demand strategies requires the engagement of the public and private sector as well as of the society at large [18].

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