A Comparative Study of Water Management in Perth and Singapore

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Executive Summary

Water is imperative in life, but due to its scarcity, countries have put in concerted efforts to be meticulous in water usage. However, in face of the burgeoning population, the problem of water scarcity is now insurmountable if we were to only consider the aspect of water conservation. It is thus necessary to source for new supplies, be it the discovery and increase in accessibility of more natural water sources, or the inventions of groundbreaking water technologies. In this report, we shall scrutinize measures taken by Perth and Singapore to increase their water supply. Apart from water conservation, we shall also look at what methods are unique only to these countries. In Perth, it is the search for groundwater; In Singapore, it is NEWater. We will then explore the comparison between these two cities approaches, analyzing from the environmental, economic, social and political views. In preparing for this report, we have conducted literature reviews from various online resources and face-to-face interviews with professionals.

Introduction

Water is finite, and the issue of water scarcity has been heightened due to rapid economic growth, increasing population and changes in atmospheric conditions. There is a compelling need amongst nations to develop new sources of water to ensure that this issue does not cripple the nation’s development.

As we discuss more on the issue of water sustainability plans in today’s society, we will take into account the case studies of two developed countries, namely, Singapore and Perth.

In the past, Singapore was highly dependent on Malaysia for her water supply. However, out of the 3 water agreements Singapore held with Malaysia, 1 expired in 2011 and the others are soon to expire in 2061. Prior to the expiry of the agreements, Singapore has come up with various new technologies to source for water. One of them is the implementation of NEWater technology, which involves the production of high-grade reclaimed water from treated, purified used water. (PUB Singapore, 2014) NEWater will form the bulk of Singapore's water from 2060 onwards and it has been predicted to meet up to 55% of our future water demand.

Till now, Perth has been very much dependent on its groundwater. Groundwater is
water accumulated in the aquifers when rainwater percolates through the rocks and soils. (Water Corporation, 2014) However, in recent years, Perth has seen a significant reduction in its rainfall. As a result, there is an imminent need for Perth to come up with alternative sources of water, which are climate-independent.

This paper aims to discuss the different water strategies adopted by both Singapore and Perth due to differing environmental, economic, political and social factors. The paper will then provide insights on how both countries handle the issues of water management.

Methodology

The study is based on a literature review of water sustainability situation in Perth and Singapore, from the Internet, seminars attended at Curtin University as part of the Study Trip, and interviews with the two Curtin University Professors, namely, Professor Peter Newman (Curtin University, 2013) and Dr Jeff Charrois (Curtin University, 2012). Professor Peter Newman teaches Sustainability at Curtin University and he has been working on sustainability projects in Australia for more than 10 years. Dr Jeff Charrois is an Associate Professor at Curtin University and has been researching on the topic on water in general for years.

Perth’s Water Strategy

Due to the seasonal rainfall pattern in Perth, relying on the highly erratic rain for water supply can be problematic. Based on Perth’s rainfall data from 2011 – 2013, rainfall can swing from an average of 35.7mm in Summer to 477.2mm during winter. (Water Corporation, n.d.) Water Corporation, the official governing body of Perth’s water services, adopts a balanced approach towards achieving climate resilience in terms of reducing water usage, promoting water recycling and diversifying into new sources of water. The following are some of the main water supply solutions that seek to drought-proof Perth and secure a sustainable water supply for future generations:

Figure 1: Pinnacles Desert in Perth depicting low levels of rainfall during the dry climate.
1. Reducing water use

Perth focuses on increasing water efficiency to achieve a 15% reduction of water use across all households and businesses by 2030. (Water Corporation, 2013) Apart from the close target monitoring of actual per person water consumption, Water Corporation has introduced a slew of projects in partnership with a range of industry groups to reduce water usage. One notable example is the introduction of the two-days-per-week sprinkler rosters for gardens in Perth. By 2011/12 this scheme achieved an annual saving of 53 billion litres of water which was the biggest contributor in water savings among all the water efficiency programs introduced. (Water Corporation, 2013)

2. Water recycling

Water recycling is an essential component of Perth’s strategy to secure sustainable water supplies. Perth recycles water through large scale schemes of wastewater treatment to suit its intended use. By 2030, Perth aims to recycle 30% of its wastewater. Currently, 13.5% is being recycled. (Water Corporation, 2013)

There are several schemes that aim to recycle wastewater in Perth. One unique example is the dual reticulation recycling schemes which separates water into two different pipes – one for drinking, another for non-drinking purposes. Recycled water is channeled to the non-drinking pipe that may be used for purposes such as irrigation or toilet flushing.

Another innovative water recycling scheme adopted in Perth is groundwater replenishment. Wastewater is rigorously treated at the Advanced Water Recycling Plant to high-quality, drinking water standards. The treated water is then recharged into the ground to replenish the depleting groundwater supply to ensure that this source of drinking water remains sustainable for the future. In 2012, the 3-year Groundwater Replenishment Trial was successfully completed in Perth and conclusively demonstrated the viability of groundwater replenishment as the next new climate independent water source for Perth.

3. Diversifying water sources

Perth seeks to secure more climate-independent sources of water to achieve a sustainable supply of water. By 2030, Perth aims to develop up to 100 gigalitres of new water sources. Main water sources in the portfolio include:
a. Desalination – approximately 150 billion litres of water is supplied annually by desalination at Perth’s two desalination plants. This makes up to almost half of Perth’s water needs. (Hamilton, 2011)

b. Groundwater – Perth is currently expanding into a new deep groundwater network which would allow water to be removed from deeper aquifers such that the negative impact on the natural environment would be reduced. It is estimated that by 2022, around 50% of Perth’s drinking water would originate from secure deep groundwater sources. (Water Corporation, 2013)

c. Dams – Traditionally used as rainwater catchment areas, the dams in Perth are now gradually taking on a different role as storage reservoirs for water produced from other sources, such as desalination and deep groundwater, for distribution to households and industries. Water Corporation has increased the connectivity of dams in recent years to provide a wider range of access to water sources.

d. Stormwater – Stormwater is the runoff from road surfaces after a rain or storm event. As stormwater is a significant part of the urban water cycle, Perth is looking towards developing a more water sensitive city to complement this cycle. The Water Corporation has been supporting the innovation in stormwater management at the city and precinct scales. The move towards better stormwater management creates an alternative water source for non-drinking purposes.
Singapore’s Water Strategy

Singapore has a small land area to collect and store rainwater, and historical problems such as water pollution and flooding have been prevalent. In the last 50 years since its independence, much investment and innovation have been brought into the picture in the continual effort to ensure sustainability and diversity of the country’s water supply for years to come. Called the “Four National Taps”, these sources are managed by the Public Utilities Board (PUB).

1. Imported Water

Singapore has three bilateral agreements with Malaysia to import water – one which expired in 2011, and the other two will expire in 2061. The latter agreements allow Singapore to draw water up to 250 mgd (million gallons per day) (PUB Singapore, 2010).

2. Local Catchment Water

Singapore has a vast network of rainwater collection avenues such as reservoirs, drains, rivers before water is treated for drinking or industrial purposes. Furthermore, Singapore is one of the few countries which attempts to use urban storm water collected on a large scale as one of the main water supplies (PUB Singapore, 2013). An example is the Marina Barrage, which was completed in 2008, and currently 2/3 of Singapore’s land area is used for water catchment and rainwater is collected and stored in 17 reservoirs around the island (PUB Singapore, 2013).
3. **NEWater**

NEWater is an ultra-pure form of water which comes from treating used water using advanced membrane technology and ultraviolet disinfection. The four NEWater plants currently supply 15% of the water needs in Singapore and its optimal output can supply up to 30% of Singapore’s water needs.

4. **Desalinated Water**

Singapore’s current water desalination plants can support up to 25% of current water needs after the second desalination plant at Tuas by Hyflux was opened in September 2013, one of the largest seawater reverse osmosis plants in the region (PUB Singapore, 2013).

Singapore has been exploring further strategies to increase water supply, especially since one of the ‘taps’ – imported water – is expiring in less than 50 years. There are three main principles governing Singapore’s water policies: (1) to capture every drop of rain that falls on Singapore, (2) to collect every drop of used water, (3) to recycle every drop of water more than once (PUB Singapore, 2010). Singapore’s approach has been designed to be a holistic water management system within the context of urban planning. Many ambitious approaches have been adopted in order to achieve self-sufficiency for water as a national resource, as well as transforming the same resource into part of economic and environmental assets of the country. We outline here several approaches which have been or will be taken.

**Extending Deep Tunnel Sewerage System (DTSS)**

The DTSS was conceived in the 1990s as a long-term solution for used water management in Singapore; studies showed that DTSS is more cost-effective than renewing and expanding the existing used water infrastructure in the conventional way, and would take up less land in attempts to meet Singapore’s long-term needs for used water collection, treatment, reclamation and disposal. (PUB Singapore, 2013)

DTSS consists of two large, deep tunnels crisscrossing the island, two centralised water reclamation plants (WRP), deep sea outfall pipes and a link sewer network (PUB Singapore, 2013). Completed in 2008, Phase I of the DTSS comprises a 48km long deep sewer tunnel running from Kranji to Changi, a centralised water reclamation plant at Changi, two 5km long deep sea outfall pipes and 60km of link sewer (PUB Singapore, 2013).

Changi WRP, in particular, is a state-of-the-art used water plant capable of treating 800,000 cubic metres (176 million gallons) of used water a day to international standards – the core of DTSS system (PUB Singapore, 2013). The treated used water is then discharged into the sea through deep sea outfall pipes or channeled to the

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1 Based on personal communication at NEWater plant with the guide during USP visit on 13 December 2013.
Changi NEWater factory on the rooftop of the reclamation plant where it is further purified through advanced membrane technologies into NEWater (PUB Singapore, 2013).

By 2022, the phase 2 of DTSS will be completed and it will further ensure that Singapore’s water supply grows in tandem with economic growth and future demands, on top of being more environmentally friendly in its operations (PUB Singapore, 2013). The full implementation of the entire DTSS will result in a 50% reduction in land taken up by used water infrastructure, from 300 ha to 150 ha (PUB Singapore, 2013). In the long run, Phase 2 increases the water recycling rate from 30% today to up to 55% of our total water demand, further improving Singapore’s water sustainability capabilities (PUB Singapore, 2013).

**NEWater, Local Catchment Expansion and More Desalination**

Capacity of NEWater production will simultaneously increase with the implementation of Tuas NEWater factory and expansion of existing NEWater factories, along with DTSS completion, such that by 2030, desalination will be able to meet up to 20% of water demands in Singapore (PUB Singapore, 2013). More sewers and water transmission networks are also planned to transport increasing amounts of water produced and recycled (PUB Singapore, 2013).

Furthermore, the current local water catchment area (67% of land area) will be expanded to 90% by 2060, enhancing the water supply as well as the aesthetic value of Singapore’s urban designs by integrating water as one avenue to improve quality of life.
(PUB Singapore, 2010). Water is expected to go beyond its most fundamental function such that it would also take part in supporting recreational and community-based activities, as well as adding values to Singapore’s landscape beautification. Marina Barrage and Kallang River at Bishan-Ang Mo Kio Park are two examples of such effort, involving many bioengineering techniques and architectural planning, which showcases Singapore’s emphasis on R&D in its effort to manage water resources and integrate it in urban planning (PUB Singapore, 2013).

![Figure 5: Marina Barrage as seen from another angle. Shown here that the damming of Marina Channel serves not only to increase water supply but also for beautification of the landscape of the country.](image)

![Figure 6: Image of Kallang River at Bishan-Ang Mo Kio Park. Retrieved on 24 January 2014 from PUB website: http://www.pub.gov.sg/abcwaters/ExploreABCAroundYou/Pages/KallangRiverBishanPark.aspx](image)

**Underground Exploration**

Studies are in progress to understand the potential of tapping aquifers and exploring the use of underground caverns for storing water (PUB Singapore, 2013). This will further improve Singapore’s water management network by fully utilizing both aboveground and underground space of Singapore’s limited land. DTSS is one existing example of how underground space is maximally used to improve water resources and at the same time open up more aboveground spaces for Singapore’s land to be exploited for better use. The possibility of this water source will be evaluated later in the discussion.
**Technological Breakthrough**

One of the continual efforts in Singapore’s R&D is to explore low-energy desalination techniques to both enhance Singapore’s green capabilities and reduce cost, given that desalination is the most energy-intensive technique in all water treatment procedures. Two examples of the areas of research involve biomimicry – mimicking biological processes by animals and plants in extracting seawater, and biomimetics – the use of aquaporins\(^2\) embedded on membranes used in water treatment plants (PUB Singapore, 2013).

Singapore has also patented her own technology in desalination processes after years of R&D in water sustainability. Called Variable Salinity Plant (VSP), it taps on water from streams and rivulets near the shoreline to augment the drinking water supply (PUB Singapore, 2013).

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\(^{2}\) Aquaporins are biological proteins found in cell membranes, capable of transporting water very rapidly and efficiently in and out of cells.
Singapore is also exploring water technologies which are geared towards “less cost per unit drop” of water. The Environment and Water Industry Development Council (EWI) awarded $4 million in June 2008 to Siemens Water Technologies to develop an electrochemical process which uses much lower energy per cubic metre of seawater for purification – extracting salt instead of extracting water as in reverse osmosis procedures (Inter-Ministerial Committee on Sustainable Development (IMCSD), 2009). There are also considerations on how to make use of heat and energy generated by water treatment processes and reuse them as much as possible, for example by employing microorganisms to break down organic particles in used water which in turn produce usable biogas (PUB Singapore, 2013).

**Water Sensitive Urban Design**

Water sensitive urban design concepts and technologies are also being explored in attempts to manage water resources for local use. It is best exemplified by the application of “Active, Beautiful, Clean (ABC) Water” design features like bio-retention swales, rain gardens and wetlands (PUB Singapore, 2013). These structures perform the roles of natural “purification mechanism” to improve water quality collected in the reservoirs and waterways – for example, there are plans put forth by URA, NParks and PUB to incorporate more biodiversity, water recycling and water sensitive design features in Marina Bay (PUB Singapore, 2013).

There has also been work between URA and HDB in the setup of experimental rain gardens, such as at Balam Estate (Inter-Ministerial Committee on Sustainable Development (IMCSD), 2009). The rain garden creates a garden habitat, promotes biodiversity and provides an aesthetically pleasing landscape. Storm water interacts with the soil and plants in the rain garden and is cleansed of litter and pollutants.

![Figure 8: View of Balam Estate rain garden. Retrieved from PUB website on 25 January 2014: http://www.pub.gov.sg/abcwaters/ExploreABCAroundYou/Pages/RainGardenBalamEstate.aspx](http://www.pub.gov.sg/abcwaters/ExploreABCAroundYou/Pages/RainGardenBalamEstate.aspx)
Discussion

Comparing Perth and Singapore

Environmental Factors

The differences in the approaches used by Perth and Singapore with regards to solving the issue of water sustainability can be attributed to the differences in the physical factors of both cities.

Figure 9: Overview of the reasons behind the different water strategies adopted by Perth and Singapore

Environmental Factors

The differences in the approaches used by Perth and Singapore with regards to solving the issue of water sustainability can be attributed to the differences in the physical factors of both cities.

Figure 10: Rainfall pattern for Perth and Singapore, year 2013. Retrieved from http://weather.sg.msn.com/monthly_averages
Perth has a Mediterranean climate, with only seasonal rainfall, very much unlike Singapore’s tropical climate that guarantees rainfall all year round. In the past few years, the rainfall pattern in Perth and Western Australia has generally changed. There has been a significant drop in winter rainfall coupled with extreme rainfall events in the summer months. Climate projections to 2030 include a 50 per cent chance of an eight per cent reduction in average rainfall relative to the 1980–99 average rainfall (Department of Water, 2009). This irregularity of rainfall makes it difficult for Perth to depend on rainwater alone as a sustainable source of drinking water, leading to the exploration of groundwater as an alternative. Currently, groundwater is the major water resource in the region, with more than 830 GL/year currently available for consumptive use. In addition, Perth’s ground has been found to be highly suitable for storing groundwater. It is sandy and hence permeable, thereby allowing water to seep through the topmost levels of the soil till it reaches an impermeable layer of rock material through which it cannot pass, or can pass only very slowly. This results in the accumulation of water in the rock layers above this impermeable layer (Foundation for Water Research, 2010).

On the other hand, Singapore has plentiful and regular rainfall, therefore making water from catchment areas a viable option for partly meeting water demands. Singapore receives an average of 2,400mm of rainfall annually, well above the global average of 1,050mm. As of 2012, surface water was collected in 17 raw water reservoirs. This reservoir water is then treated through chemical coagulation, rapid gravity filtration and disinfection. However, due to Singapore’s limited land size, it is not viable for it to depend solely on one source of water. Groundwater is not a very viable option for Singapore due to its small area, most of which furthermore, is widely urbanised, which renders the land and soil unsuitable as a storage location for groundwater. Hence it relies on four main sources of water, as mentioned before:

Therefore, we can see that differences in the geographical factors of both cities warrant differences in the strategies they adopt to tackle the water supply issue. Size, climate, and ground are all significant contributing factors in determining the most expedient policy to be used.

However, it is important to take note that in recent years Perth has realized the need to diversify, and not place all its eggs in the same basket. This need has especially been emphasized with the recent climate change, which has been taking place as a result of natural variations in climate coupled with human activity like deforestation. As a result, the groundwater available for consumptive use by 2030 may decrease to 700 and 580 GL/year for the ‘median’ and ‘dry’ climate scenarios respectively. Reduced rainfall has also resulted in falling groundwater levels across much of the region and increasing pressure on groundwater-dependent ecosystems. For this very reason, it decided to explore alternative sources of water such as desalination to ensure a sustainable supply of water independent of volatile climates.
Economic Factors

In 2012-2013, the Western Australian economy achieved a 5.1 per cent growth in Gross State Product (GSP) and is forecast to grow by 3.25 per cent in 2013-2014, the highest growth forecast for any State this year. (Department of Treasury, 2014) Indeed, Western Australia is expected to remain the fastest growing economy in Australia over the next decade with a continuous positive growth rate. This positive economic outlook and stability suggests that Perth’s 10-year water supply strategy will at least not be interrupted due to economic or financial reasons. As for Singapore, the economic sentiment is also rather positive and it is expected that the Singapore economy is to grow by 2.0 to 4.0 per cent in 2014. (MTI, 2013) This means that the government will have the financial ability to undertake any water-related research programmes or implement technological solutions.

According to the Western Australian State Budget 2013-2014, A$1.0 billion will be invested in building water infrastructure. (Government of W.A., 2013) This one-billion dollars will finance the implementation of water-related technological solutions and relevant water plans in the following year. For Singapore, a total budget of S$ 1.3 billion has been allocated to Ministry of the Environment and Water Resources (MEWR) whose mission is to ensure a clean, sustainable environment and water supply for Singapore. (MOF, 2013) Good water infrastructure and services is one of the main outcomes to be achieved in financial year 2013.

Both the Western Australia and Singapore governments have a good record of running government budget surpluses. A surplus of A$386 million is forecast for Western Australia for 2013-2014 and a surplus of S$2.4 billion is projected for Singapore in financial year 2013. (Singapore Business Review, 2013) So in the event of incurring necessary additional investment in water-related technology or infrastructure, the government always has the option of drawing from its purse.

However, it is worth noting that even in times of economic boom, the government has to allocate its resources efficiently to satisfy the competing needs in the state/country such as transportation infrastructure, healthcare and education. Governments may have different priorities at different stages of development and this will directly affect the state’s or country’s ability to conduct extensive research or implement expensive water strategy solutions.

Social Factors

Citizens of both Australia and Singapore were initially resistant to the idea of drinking treated wastewater. The ‘yuck’ factor has proven to be the most serious hurdle for similar projects around the world. A referendum was held in Toowoomba, Queensland in July 2006, in the midst of a severe water shortage. 62% of the population voted against the referendum question ‘Do you support the addition of purified recycled water to Toowoomba’s water supply?’ (Australian National University, 2008). Hence Perth crafted its water solution slightly differently, in that the treated wastewater was injected
into the ground to replenish groundwater, rather than straight into the taps. This was more acceptable to the people, as observed from a poll in August 2006, where 64% of respondents supported adding treated recycled wastewater into the ground for the replenishment of groundwater (Jerrard & Murphy, 2007).

In comparison, the NEWater campaign in Singapore was very carefully done. The government preempted a lot of psychological resistance and launched its public relations strategy early on. They showed the media what was involved and started introducing NEWater to the public through the newspapers, magazines and radio. A mascot named Water Wally promoted NEWater to schoolchildren and was featured on a television show about water. Celebrities were also spotted drinking NEWater. The marketing campaign reached a peak when 70,000 people at Singapore’s national day parade in 2002 each received a bottle of NEWater. The then prime minister, Goh Chok Tong, said, ‘Let’s drink to the nation’, and everyone held their bottles up and drank. Also, Singaporeans tend to be more accepting of government policy and are less questioning than Australians. This factor, coupled with the NEWater campaign, helped to mitigate the ‘yuck’ factor among Singaporeans (The Sydney Morning Herald, 2008).

In both Perth and Singapore, education campaigns were undertaken to tackle the ‘yuck’ factor as well. This was done by informing citizens of the methods of purification as well as scientific evidence proving that it was safe for consumption. Visitor centres were built to explain the treatment process and the region’s water needs, where the government believes that greater knowledge will bring about greater acceptance. Terminology was also an important part of gaining public acceptance. Rather than ‘wastewater’ or ‘reclaimed water’, it was termed ‘recycled water’, to form more positive associations with it. Singapore’s NEWater sounds new, while the Perth facility describes its purpose as ‘groundwater replenishment’, which emphasizes where the water is going to be (not in the taps). This reduces the focus on the fact that the water is treated wastewater, hence mitigating the ‘yuck’ factor (Galbraith, 2012).

Political Factors

With Western Australia now facing an increasingly drying climate and growing population, they can no longer depend on their dams and groundwater to provide for the
majority of their water needs. It used to be able to meet at least 50% of their water needs, but it is no longer possible with reasons explained in the earlier part of this report. This places increasing pressure on the government to ensure that the state’s water resources and water supplies remain sufficient to meet the needs of the country. As a result, Western Australia has moved away from the traditional dependence on dams and groundwater, and has increased reliance on albeit more expensive desalination plants and more recently, water recycling. They have swiftly identified that they have to increase dependence on desalination because of its climate-independent nature, and that they would have to explore other sources of water as a future plan (Corporation, Water Corporation of WA). Western Australia has, as a result, come up with water allocation plans (Water, n.d.) and several water strategies to increase their ability to meet their water needs (Corporation, Water Corporation of WA - Desalination, n.d.). In the plans and strategies, the CEO of Water Corporation and the Minister of Environment, Water have also noted the importance of not only the development of water solutions, but also the need to reduce and recycle water for the future of Western Australia.

![Figure 12: Aerial photo of Beenyup WWTP and advanced recycling plant](image)

Singapore, on the other hand, has always looked ahead of the potential water problems that we will and might face. With already little land to collect and store enough rainwater, Singapore in the early days faced droughts and water pollution issues. These water challenges have hence led to Singapore’s need to innovate and develop capabilities in the area of water management, turning our weakness into a strength. The PUB has, over the 50 years of strategic planning and investment in research and technology, built a robust and diversified supply of water known as the ‘Four National Taps’ that was mentioned earlier. However, with the expiration of the 1961 water pact with Malaysia in 2011, the government had already made plans to increase the dependence on the 3 other national taps with the publication ‘Water for All: Conserve, Value, Enjoy – Meeting our water needs for the next 50 years’ in 2010, underscoring Singapore’s water
strategies and long-term plans to meet the growing water demand (Centre, 2010). All these plans are put in place to ensure that with the expiration of the 1962 and 1990 water pacts with Malaysia in 2061, Singapore will be self-sufficient in terms of her water needs for a long time to come.

Looking at the plans laid out for the water needs of the country, the Singapore government seemed more pre-emptive in its attempts at developing water solutions. This is largely because of the knowledge of the expiring water pacts that threatens Singapore’s ability to meet national water needs. It has forced Singapore to come up with comprehensive and futuristic plans for our water needs since we became independent. Australia, however, seemed to be only diving into diversifying their water sources only when they realized that they can no longer fully depend on their traditional dams and groundwater. They were however, very efficient and effective in shifting their focus to desalination and developing technologies on water recycling in an attempt to replenish the groundwater. Instead of groundwater providing for 50% of Western Australia’s water needs in the past, it now only accounts for a mere 10% of their water needs (Corporation, Water Corporation of WA - Groundwater, n.d.). Desalination has taken over as the main water source, which now accounts for 50% of Western Australia’s present water needs (Corporation, Water Corporation of WA - Desalination, n.d.). Water recycling technology has also worked out well in a 3-year trial in different parts of Western Australia. Their swift recognition and implementation of change has hence enabled Western Australia to resolve their problem of the potential lack of water due to little rainfall.

Both Western Australia and Singapore are right now on the track to achieving self-sustainability in terms of their water needs with the use of technology that is best suited
to each country’s geographical, demographic and psychographic factors. Both countries have something to learn from the other. The Singapore government has been able to make such long-term plans also because the ruling party has remained in power for a long time. This constancy of government allows plans to come to fruition. Australia on the other hand does not have such constancy in government and this may be the reason why long-term plans may not be as effective there. There is no doubt that Western Australia started later with the use of water recycling as a sustainable source of water and is looking at NEWater as a model, but the efficient government implementation of the policy is something that Singapore can learn from (even though the long-term plans are no doubt as effective).

Conclusions

In the age where sustainability forms a significant portion of the agendas of many nations, there should be continual investment in innovation and research in conservation and sustainable development. As the population grows, and demands for water and energy increase over the years, there is no real limit to how far we should improve water management or when we should consider the efforts to be enough. Around the world, indeed there have been numerous moves in order to push towards being more environmentally-friendly, one epitome being “100% renewable energy cities” - but it is certain that much more can be done. Complexities often arise, not only financially but also in the political domain; at times it is a matter of political will and perseverance which hampers progress in sustainability efforts, competing against economic agendas.

Governments of both Perth and Singapore have been actively seeking new and innovative alternative solutions to secure a reliable and sustainable water future for their urban cities. While there is no cookie-cutter approach to the problem of water scarcity due to the unique features of each location, other countries or cities may vicariously gain insights from these countries’ water management policies. Water-sensitive urban design, which Singapore adopts, could be readily applicable across any city as there are no real technological or architectural constraints in its implementation; political will is one necessary prerequisite to decisively set aside part of the government’s resources to actualize such plans. There is no significant economic burden in such efforts, and there are ongoing projects to keep innovations in sustainability as low-cost and energy-efficient as possible. This report, in a way, is a demonstration of how sustainability can be fully appreciated in all its complexities, and is perhaps not as difficult to drive and initiate after all.

References


**Images**


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We are a group of NTU students in the University Scholars Programme. Our majors include Business, Accountancy, Engineering and Science. We set out on a 6-day study trip to Perth in January 2014 with the aim of learning about sustainable practices in Perth, particularly those in relation to water sustainability. This paper highlights the key information and insights we gathered during the trip, which has helped us greatly in understanding the issues and practices of water sustainability in Western Australia.