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Water Leaders Summit 2016: Future of World's Water beyond 2030 – a retrospective analysis

Introduction

> The world is changing rapidly. Much more rapidly than many of us realise. I am convinced that the next thirty years, the world of water management will change more significantly than perhaps the last three hundred years. (Asit Biswas, distinguished visiting professor, Lee Kuan Yew School of Public Policy)[1]

A change in the way we use and manage our water resources is inevitable. This change *will* transpire – whether to adapt to the undesirable or to attain the desired – and will be driven by many factors – almost all of which are human-influenced, directly or indirectly (Rockström et al., 2009; Steffen et al., 2011).

The irrefutable, observed change in the climatic system will result in major alterations to the hydrological cycle due to the increase of ambient temperature; and in turn will make extreme hydrological events more frequent (Intergovernmental Panel on Climate Change [IPCC]), 2014). The hydrological cycle will intensify, with more evaporation and more precipitation in some parts of the world, potentially increasing the frequency and magnitude of flooding events. Elsewhere, significant reductions in precipitation will be experienced, resulting in frequent and prolonged droughts.

In 2011, the world population breached the seven billion mark. This is more than 250% of the global population in the middle of the twentieth century. According to the Department of Economic and Social Affairs, United Nations (2015), by 2030 a projected 8.5 billion people will be living on this planet – and by the turn of the next century, over 11 billion. And corresponding to the increase of population will be the surge of water demand and consumption.

Water will be required in the agricultural industry to feed thriving populations. Today, food production already consumes more than two-thirds of the world's extracted water, and food demand is expected to rise by 70% by 2050 (Gilbert, 2012). A dietary shift – a shift from a primarily plant- and starch-based diet to one that has a higher proportion of meat and dairy products, which requires more water to produce – is also expected, in parallel with economic development and the subsequent improvement in individual wealth. Producing 1 kg of rice, for example, requires about 3500 L of water, while 1 kg of beef requires 15,000 L (Hoekstra & Chapagain, 2008).

Population and economic growth will increase not only water demand but also waste generation. This increase will be not only in quantity but also in variety. According to the United Nations Environment Programme, two million tonnes of domestic sewage plus industrial and agricultural waste is discharged into the world's water bodies every year (Corcoran et al., 2010). From the same report, in developing nations an estimated 90% of all wastewater

is discharged directly into rivers, lakes, seas or oceans without prior treatment. From untreated domestic sewage, a myriad of pathogens of a variety of classes (virus, bacteria, protozoa and helminth) are responsible for the deaths of 1.8 million children under the age of five annually (Corcoran et al., 2010). Domestic wastewater, along with agricultural and industrial wastes, also contains carcinogens, endocrine disruptors and other health hazards – many of which can remain in the environment for a long time. And for some chemical substances that do degrade, the products of degradation can potentially be more toxic than the parent compounds.

We currently do not possess the technical capability to accurately and efficiently detect and measure *all* of these microbiological and chemical pollutants. Furthermore, relative to water *quantity* monitoring, water *quality* monitoring incurs significantly higher costs – a massive stumbling block in water resource management for poorer developing countries that need it more urgently than their first-world counterparts. How can we manage what we cannot measure?

In the face of such complexity and uncertainty, how then can we prepare ourselves to safeguard the future of our water resources? To discuss this, Asit Biswas organized, chaired and moderated the flagship session of the 2016 Singapore International Water Week, "Future of World's Water beyond 2030". The session had four panellists: Ng Joo Hee, chief executive of the Public Utilities Board (PUB, the national water agency of Singapore); Peter Brabeck-Letmathe, chairman of the board of Nestlé Group; Venkatesh Kini, president of Coca-Cola Company (India and Southwest Asia); and David Molden, director-general of the International Centre for Integrated Mountain Development. The following sections are based on the discussions of this panel, supplemented by some reflections by the authors.

Lessons from the public sector: the Singapore strategy

> I like to tell people who ask what our secret is when it comes to water governance – we share the secret openly. The trick for us is to manage the water system as an integrated whole. (Ng Joo Hee, chief executive, Public Utilities Board, Singapore)

Traditionally, all aspects of water management are considered the responsibility of the public sector. It is evident that a capable government that plans, manages and implements effectively can flourish, not only in the water sector but in all aspects of national development. While many reasons – the most common of which are often related to geographical constraints, e.g., physical scarcity of water – can be touted as causes of the various water-related woes, these are not without readily available solutions. Every country and region has its own set of unique quandaries. The quality of solutions hinges heavily on how the problem is managed.

This then brings to light a cascade of pertinent questions: Why are some governments more effective than others? What allows them to outperform? What are the lessons that can be learned from some of these success stories? The Republic of Singapore appears to have some answers to be considered to these questions.

The challenge for Singapore, when it comes to water, has been and will always be scarcity. That was the case when Singapore became independent, over 50 years ago. It is still a challenge today and will continue to be the prime concern in this fast-growing nation, which is projected to have a population of 6.9 million by 2030 – approximately 25% more than today (National Population and Talent Division of Singapore [NPTD], 2013). The Water Resources

Institute (2015) ranks Singapore at the top of its list of the most water-stressed countries in the world – an unenviable spot shared with many predominantly desert countries, including Qatar, Bahrain and the United Arab Emirates – above the likes of Saudi Arabia, Kuwait and Oman. Unlike these arid countries, Singapore receives bountiful rain: up to 2400 mm annually, more than twice the global average of 990 mm.

One of Singapore's earliest countermeasures for water scarcity was to import its water. This, however, is not unusual for metropolises around the world. Every major urban centre is compelled to bring water from beyond its boundaries to quench the thirst of the inhabitants within. The ancient Romans had aqueducts to transport water from distant sources to their cities and towns. Hong Kong is dependent on mainland China for water, getting most of its supply from the Pearl River. The founders of New York City had the foresight to secure over 5000 km^2 of pristine watershed (about seven times the area of Singapore), which today supplies over five billion litres of water daily to eight million New York City residents and one million upstate customers.

Singapore imports its water from the Johor River, in the state of Johor, Malaysia, approximately 50 km to the north of its boundary. Therein lies the conundrum: Singapore is both a city and a country. Unlike Hong Kong and New York City, where the imported water is supplied from within their own political boundaries, Singapore must rely on a transnational source of water – one which, by 2061, will most likely cease to be a viable option when the agreement signed in 1990 to allow Singapore to draw water from Malaysia expires. Appreciating the historical water-related conflicts between the two countries, and thus the unreliability of imported supplies, Singapore set out to achieve its own water independence.

A major turning point in the water revolution of Singapore occurred at the turn of the millennium, when PUB was constituted as the national water agency, by taking over the drainage and sewerage functions from the Ministry of Environment. This allowed PUB to assume complete control of *all* the freshwater resources in the country. Stormwater is collected and conveyed via the extensive drainage network to local reservoirs to be treated and reproduced as drinking water. Today, two-thirds of the land in Singapore has been converted to water catchment areas. By 2060, 90% of the republic's land area will be able to capture rainwater for storage and thereafter conversion to drinking water.

Having absolute control over the island-wide sewage collection network and treatment facilities also allowed PUB to tap an unconventional resource in the form of used water (or wastewater) for the production of drinking water. Recycled water, branded as NEWater, from four water reclamation plants across the country can now meet up to 30% of Singapore's water needs. By 2060, NEWater is expected to meet up to 55% of Singapore's future water demand.

Another unconventional source – a climate-resilient source – of water comes in the form of seawater. The idea of desalinating seawater to expand supply goes as far back as 1972, less than a decade after Singapore's separation from Malaysia in 1965. It took over 30 years of perseverance, when leaps in technology enabled seawater to be desalted at lower cost and with less energy, for this to become a reality; the first desalination plant was opened in 2005. Today, two desalination plants with a combined capacity of 100 million gallons per day can meet 25% of the water demand in Singapore. By 2060, desalinated water will meet up to 30% of Singapore's future needs.

Having solved the water scarcity challenge today and for the future, PUB acknowledges that a second challenge was created in the process. The alternative, unconventional sources of water (recycled and desalinated) require much higher energy consumption, and therefore have higher costs. Today, the production of 1 m^3 of drinking water from rainwater requires only 0.2 kilowatt-hours (kWh) of energy, but it takes 1.1 kWh to produce the same amount of NEWater and 3.5 kWh to desalinate 1 m^3 of seawater. Given that recycled and desalinated water will make up at least 85% of the future demand, PUB once again is tasked to overcome another challenge: to reduce the energy requirements for the production of recycled and desalinated water. PUB's current target is to reduce the energy requirements for these processes by half. Over the last decade, a total of SGD 470 million in research and development funds has been allocated to the water industry to aid this cause. Another SGD 200 million for the next five years has also been generated by the National Research Foundation to further cement Singapore's status as a global hub of water purification technology. Mr. Ng is confident that this target will be met in the next few years. Once this is achieved, PUB will strive to halve the energy requirements again.

One can argue that, backed by its wealth and status as a first-world country, Singapore can afford sophisticated and advanced technological innovations to achieve its resilience of water supply today. However, lest we forget, it was only 51 years ago, merely a generation ago, that Singapore was separated from Malaysia as a young, developing nation devoid of any form of natural resources. About 30% of the country's population today witnessed this separation and lived through the transition. Without question, it was the forward thinking of the leaders then that ensured the water resilience Singapore is reaping today, and it seems it will be the far-sightedness of the leaders today that will guarantee this and ultimately the prosperity of future generations.

Lessons from the private sector: Nestlé and Coca-Cola

> How can you make water a priority for an organisation like Nestlé? Very clearly, it has to come from the top. The first to be convinced has to be the chairman and the CEO, the board and then afterwards, bring this message through the whole organization. (Peter Brabeck-Letmathe, chairman, Nestlé Group)

Just as the late Lee Kuan Yew ensured that water was made a priority in the framework of the national development of Singapore, the private sector is increasingly translating this notion into its business practices. Companies like Nestlé and Coca-Cola are ingraining effective water management in the DNA of the entire institution, and are changing the corporate culture to prioritize good water practices. In addition to using water-saving technologies and developing zero-water factories, these companies have many innovative and out-of-the-box approaches to water management, which can serve as lessons for a myriad of industries and public sectors alike.

The cost of implementing water-saving technologies is one of the biggest barriers to their widespread use in the public and private sectors. Nestlé approaches this problem in a very interesting way. When Nestlé understood that in many parts of the world, the water for industry and for agriculture did not have a value, they introduced the concept of internal shadow pricing. In their internal calculations, they gave water a price, varying with the water availability of the region. In agricultural areas with plentiful water and rain, a price of USD 1/m^3 was used, while in water-scarce areas, a price of USD 5/m^3 was assigned. The result was

that, suddenly, it was financially viable to introduce water-saving technologies in their factories, globally. This completely changed the way Nestlé handles water internally.

Coca-Cola has reduced its water usage ratio (the amount of water required to produce one litre of finished beverage) by over 25% in the last four years in India. They also hold their plants to standards that are typically higher than what most local governments in India require. Going the extra mile, Coca-Cola has set up, along with Teri University, one of the leading environmental universities of India, a Centre for Regional Water Studies, whose goal is to produce water experts. Understanding that there is a large shortage in India of hydrogeologists and water experts who understand the subject end to end, they now aim to create a team of PhDs and MSc students who can work in government, industry and NGOs to improve the management of water in the country.

The credit for the success of such concepts, developed and implemented by multinationals like Nestlé and Coca-Cola, must go to the management of the company. It is the leaders who define the priorities and the values of the company, and it is they who decide how far the company will go to stand by these values. While one can argue that consumers can change industrial practices by only accepting products that meet certain standards, sadly, the fraction of conscious consumers is too small to have a large impact in the current setting. Thus, in the private sector the thrust has to be top-down. There is an evolution now as we see more companies take a long-term perspective and recognize that water conservation is not only a matter of business efficiency; water is the linchpin for growth.

> We recognized that as a visible brand and a visible user of water, we need to lead by example. (Venkatesh Kini, president, Coca-Cola Company, India and Southwest Asia)

In addition to these real challenges, many businesses, notably the food and beverage industries, also have to deal with perception, as water is the main and most visible ingredient in most of their products. This can serve as a challenge and as an opportunity for these industries. Managing the perceptions of the community in which their factories are located is of paramount importance. There have been instances in which Pepsi Bottling and Coca-Cola were forced to close down plants in India that local farmers and urban interests believed were competing with them for water. To avoid such situations, Coca-Cola endeavours to locate new factories in places that have surplus water and are projected to have a surplus for many decades. Whenever water shortages and constraints do arise, they concentrate production in areas of water surplus, reducing production in places where water is in shortage. In addition to this, Coca-Cola has under their umbrella an array of community development efforts that are carried out in communities directly involved with the company. They also engage in agriculture development programmes with the government to reduce the water footprint of agriculture as an agricultural product, and with farmers and suppliers to reduce the end-to-end water footprint.

It is arguable that the motivation to implement some of these solutions comes from the fact that they are necessary to ensure the smooth running of the business. Community development programmes, while benefitting thousands of locals, also directly impact the functioning of the businesses; communities tend to support and defend businesses whose leaders have made the effort to build strong local community connections. The past has also seen many environmental lawsuits against major players in the industry, and there is no dearth of material in the media that highlights the damage that industry does to local water bodies and the environment as a whole. However, what is important at this time is to

understand that initiatives and actions that the private sector takes to conserve water will have a very high impact in ensuring the future of our planet's water.

After agriculture, industry is the second-largest user of water. Even though we now see more and more companies handling their water resources responsibly, there are still many that do not. While company values are enough to drive many companies to go this extra mile, the associated costs, lack of regulations and their poor implementation prevent water conservation from being completely institutionalized in the private sector. This calls for more platforms wherein industry players can learn best practices from their counterparts and interjections of the public sector in defining stronger regulations and/or providing incentives to the private sector to manage the water they use responsibly and efficiently.

Conclusions

> Changes are coming, whether we like it or not, they are coming fast and they are going to be complex. So, we have to work together – public sector, private sector, academia, non-governmental organizations, as well as the water and development professionals and the media – to anticipate the problems and see how each could be overcome. (Asit Biswas)

The Sustainable Development Goals, officially known as Transforming our World: The 2030 Agenda for Sustainable Development, are an intergovernmental set of aspirational goals spearheaded by the United Nations (https://sustainabledevelopment.un.org/). Goal 6 is to ensure access to water and sanitation for all. The World Economic Forum in Davos has now for the second year identified water as the global risk of highest concern for the next 10 years (World Economic Forum, 2015, 2016). Water availability also tops the list of concerns of the public sectors of all nations. In order to ensure the future of our water, industry, government and civil society have to come together to find solutions that are practical, implementable and commercially viable. These solutions will have both technological and governance components.

Technological solutions exist, and there is no question that science and technology will improve significantly in the future. The planet as a whole already has the technical capabilities to solve all its water woes. The problem, however, is that these solutions come at a cost. The biggest challenge for governments is to find the right equilibrium between water as a human right and water as an economic good. Until now the emotional aspect of water as human right has dominated the global water discourse, and this has impeded making the necessary investment on the other side. This has impacted the poor and the vulnerable sections of the society the most. In Singapore, there is no right to free water. Everyone must pay for the first molecule of water consumed. Water is priced in this manner because the government recognizes that if water is provided at no charge, maintaining, expanding and improving the water infrastructure will eventually become a serious financial liability. The question then becomes: How do we ensure that there is an efficient mechanism, like that of the Singapore government, to provide water to the people who need it most, in efficient ways? The reason that Singapore today can boast of a successful water story is the strong, determined and far-sighted leadership it has always had. Leadership and good governance is the key when it comes to the success of the nation as a whole, the success of a particular ministry, the success of a small project or the growth of a private industry.

Nations around the globe are struggling today to meet their water requirements. Mismanagement, old and poorly maintained infrastructure, lack of infrastructure, population

explosion and its associated stress on the system, poor financial health of the water utilities and lack of skilled workers are among the many reasons why these utilities are fighting a very difficult battle. The nature of this problem is such that there is no one solution. There is no algorithm or procedure that can be followed to relieve nations of their water woes. There are however best practices and examples to learn from.

Taking a page out of the *Singapore Water Story* (Tortajada, Joshi, & Biswas, 2013), one lesson that we can learn is that good, responsible, leadership can and has to pave the way towards foundation for improvement. It is clear that the private sector is contributing to improving the state of water globally. The public sector can help institutionalize this across the private sector by means of stronger regulations and incentives which are fairly implemented. At the same time, as the private sector is a major user of water, it is essential that they are included and consulted in establishment of major global projects as they bring in their experiences and concerns. The establishment of the Sustainable Development Goals is a major breakthrough in this regard as – unlike its predecessor, the Millennium Development Goals – the role of the private sector in water management is considered for the first time.

A very critical component of this story that we often overlook is the consumer. Looking at the picture from a different angle, demand management can help alleviate the stress on water utilities to a large extent. To put this in perspective, as Professor Biswas pointed out, an average Qatari national uses 1200 litres of water per day, and this is after some 40% of system losses. An average Danish citizen uses 107 litres of water per day (DANVA, 2015), and in Leipzig, 90.7 litres (Leipziger Versorrungs & Verkehrsgesellschaft mbH [LVV], 2016). When multiplied by the population of the nations, demand management appears to be a large untapped potential. The industrial and agricultural sectors can similarly help alleviate water stress by improving efficiency. While national campaigns are effective in raising public awareness, the amount of water used by a household or an industry is strongly influenced by its cost to the user. This once again highlights the importance of the right pricing of water.

The complexity of ensuring the future of our water, on the one hand requires us to look at individual problems and solutions as mentioned above, and on the other hand mandates that we do not lose sight of the bigger picture in these discussions. A key lesson of the Singapore water story is its practice of integrated water management. This lesson can be extrapolated to bring to light something very important. If you look at two of the most important needs that humankind has, they are undoubtedly food security and energy security. The nexus between these is water. Without water there is neither food security nor energy security. Understanding and addressing this nexus is very important. Solutions that will prove to be effective will involve players not only from the water sector but also from various associated sectors.

In addition to all the other anthropogenic challenges we have created, there looms the threat of climate change. To future-proof the water industry we have to deal with the uncertain challenges that climate change will bring. Planning for climate change will remain complex and will require the right mix of research and institutional responses.

It is overwhelming to try to grasp the magnitude of this problem. When one tries to look at the entire picture, it seems that there is a tremendous task ahead of us. From simple installation of meters in urban areas to trying to predict and prepare for the impacts of climate change, it seems like we have to do it all! On looking more closely, however, we realize that it is not a problem of water availability. We have the water; it's just not managed right. It is either in a location too far away, with no infrastructure to transport it, or simply too

contaminated to use. In some places we are simply overusing the water, and in others we have no ability to collect it when it rains. The problems lie in management, not the physical quantity of water; with the combined efforts of the public sector, the private sector, academia and NGOs, we can future-proof our water.

Note

1. All quotations are from statements made at the Water Leaders Summit unless otherwise indicated.

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