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EDITORIAL

Water crisis and water wars: myths and realities

In recent decades, 'water crisis' and 'water wars' have become increasing concerns of water professionals, political scientists and the media. Both start with the simplistic and erroneous assumption that the quantity of water available in the world for human use is limited. This, coupled with the fact that population, urbanization and industrial activities are all steadily increasing, is used to predict that the world is facing a water crisis of unprecedented proportion, which may even result in wars between countries over water.

Projections in recent years by major international organizations have been consistently dire. For example, in 2009, the 2030 Water Resources Group projected that the world would face 40% water deficit under a business-as-usual climate scenario. In 2016, UNEP claimed that by 2030 almost 'half of the world's population will suffer from severe water stress'. In 2017, UN Secretary-General Ban Ki-moon proclaimed that by 2030 the 'world may face 40% shortfall in water'. The World Bank has claimed that by 2050, about 1.8 billion people will be living under acute water scarcity. In 2018, the World Bank and the UN claimed that 36% of the global population lives in water-scarce areas. The World Resources Institute (WRI) claimed that 33 countries will face 'extremely high water stress'. According to the WRI analysis, seven countries will jointly rank as number one in terms of the most water-stressed countries of the world. All of them are in the Middle East, except for Singapore.

These are frightening statistics that have been repeated *ad nauseam* by academics, water professionals, political figures and international organizations without any serious scrutiny of the validity of their underlying assumptions, the methodology of their estimates, or the national and international data-sets available and their quality.

The fundamental question that arises is, are such frightening forecasts correct, or should they be taken with a very big pinch of salt? Probabilities are, it is likely to be the latter.

First, as every school kid knows, water is a renewable resource. It is not like oil, natural gas or coal, which after being used break down into different components and cannot be used again. Water, by contrast, can be used, and the wastewater generated can be treated and reused. Properly managed, this process can continue indefinitely. Thus, how much renewable water a country has is not a meaningful metric. When the World Commission on Water started its work, one of the first decisions it made was that no attempt would be made to estimate how much water a country, or the world, had that could be used, because it is not a meaningful number. How much water is available for use will depend primarily on how well this resource is managed.

Yet most international and national institutions have decided that if a country has less than 1700 m^3 per person of renewable freshwater, it is suffering from water stress. If this figure falls below 1000 m^3 per person, it is facing scarcity.

This muddled thinking explains, to a significant extent, the absurdity of WRI's ranking Singapore as one of the world's seven most water-scarce countries. By the current widely accepted standard, Singapore has only about 110 m^3 of freshwater per person, which, according to WRI, makes it as water-scarce as the other six most water-scarce countries: Bahrain, Kuwait, Qatar, San Marino, United Arab Emirates and Palestine. However, if one asks any Singaporean citizen if he/she has seen any sign of water scarcity, the answer will most definitely be no.

Singapore did have serious water problems when it became independent in 1965. By improving its water management practices very significantly, it has not had a water problem since about 1980, even though its population has more than tripled, from 1.89 million in 1965 to 5.86 million in 2019. Equally, its per capita GDP has increased during the same period, from USD 516 to USD 55,600, an astronomical 108-fold increase. Yet, in spite of this phenomenal growth, and very low freshwater availability, Singaporeans do not feel any signs of water stress, let alone scarcity. By 2061, Singapore's water demand is expected to double, and the water currently being imported from Malaysia, accounting for 50% of supply, will stop completely. Yet, with good planning and management Singapore does not anticipate any serious water problem before or after 2061.

Compare Singapore and Qatar, two countries WRI considers to be facing the most serious water scarcity problems. Singapore's domestic water use is 143 litres per capita per day (lpcd), and unaccounted-for losses are 5%. Thus, Singapore has to produce 150 litres so that an average Singaporean receives 143 litres at home.

In contrast, an average Qatari national uses 1200 lpcd, with unaccounted-for losses conservatively estimated at 35%. This means Qatar has to produce 1620 litres so that an average Qatari receives 1200 litres at home. Thus, Qatar has to produce nearly 11 times as much water per person as Singapore does. In addition, a Qatari national does not pay for water. In Singapore, the domestic rate is fixed at the marginal cost of producing the water.

With additional new policy instruments, we expect Singapore's water use to be well below 100 lpcd by 2040. Already several Belgian cities are using less than 70 lpcd.

In terms of industrial water use, which is increasing the most in terms of total percentage in global use, major multinational corporations like Unilever and Nestlé are leading the way to reduce their water footprints very significantly. Unilever reduced total water abstraction for its factories by 44% between 2008 and 2018. It reduced its total water abstraction in 2018 by 7.2% compared to 2017. It has saved 22 billion litres of water compared to 2008, with very significant increases in production.

Unilever's average payback time for measures to increase water use efficiency has been just over two years. Reduced water consumption has also reduced its energy costs, since less water had to be pumped and heated, and less wastewater had to be treated. Between 2008 and 2017, water conservation reduced Unilever's annual energy bills by €105 million.

Similarly, Nestlé reduced its water withdrawals per tonne of product, for every product category, by 29.6% between 2010 and 2018. Its most innovative idea has been zero-water factories. By installing condensate recovery units for milk, which is 88% water, it made its plant in Lagos de Moreno, Mexico, a zero-water factory. The plant does not abstract water from outside sources. Similar total water savings have been achieved, or soon will be achieved, in six plants in Brazil, and one each in China, India, Pakistan, South Africa and California (Biswas & Tortajada, 2019).

Many other industries are now following the footsteps of Unilever and Nestlé, and increasingly more corporations are likely to go this route.

Agricultural water use, the largest user of water in the world at 70%, is also becoming more efficient. Globally, water used by agriculture, as a percentage of total water use, has been steadily declining for over a decade. China dramatically reduced its agricultural water abstraction per hectare of irrigated land, by 20%, between 1990 and 2012 (Doczi, Calow, & d'Alançon, 2014). The emphasis on improving agricultural water use efficiency has increased very significantly since then. Importantly, food production since 1990 has continued to grow steadily, as have its economic activities. China is successfully decoupling its economy from water use. Between 2012 and 2017, China reduced its water consumption per RMB 10,000 by 30%, while increasing industrial value added by 52.9% (Wang, 2019).

With the increasing emphasis on water conservation and pollution at China's highest political levels, by 2030, water use is likely to decrease even more dramatically compared to what has been witnessed in the past.

More and more countries are being forced to improve their water management practices, since they have no real alternative. Industries are realizing they can survive and thrive only by steadily improving their water efficiency. The general public is becoming aware of the value and the cost of water and of the uncertainties posed by climate change to all related sectors. Cumulatively, all these developments will ensure that the global water scene by 2030 will be very different from the present. A by-product of all these changes is likely to be that the present misguided focus on scarcity due to physical lack of water will move to considering how best water management practices and processes can be improved so that significantly more can be done with the same quantum of water and its regular reuse.

A direct by-product of the current limited thinking has been the increasing focus on 'water wars' between countries because of lack of water. This thinking is both linear and wrong. Simply put, the thinking goes that as countries run out of water because of steadily increasing demand, they may go to war over water over the uses and allocations of transboundary river waters. This unwarranted preoccupation with water wars can be seen by simply referring to Google. As of 20 June, 'water scarcity' produces 34.2 million results, and 'water wars', 654 million – almost 20 times as many. In fact, an eminent development expert, Ismail Serageldin (2009/2010), former vice president of the World Bank and chairman of the Global Water Partnership, predicted in 1995 that 'the wars of the next century will be about water.'

The fact is that in the entirety of human history, no two countries have ever gone to war over water. The price of water all over the world is very low, and there is no global market or trade for water, unless one considers bottled water, which represents a miniscule fraction of global water use. All countries are steadily realizing that they have to significantly improve their management practices to reduce the demand for all types of water uses and to control water contamination. No country can increase water availability progressively, constantly and cost-effectively *ad infinitum*. If countries make determined and sustained efforts to improve water management practices, and there are signs that some are gradually doing so, their water problems can be solved. As Biswas (2006) noted in his Stockholm Water Prize Lecture, 'if ever there is a war between two countries, it will never be because of water. Perhaps the

10th or 15th reason for the war could be water, but not the first three'. In the future, countries will have to manage their water significantly better, because they will have no other choice. 'Water wars' is a myth that has been around for at least four decades. There are no signs that they will occur in the foreseeable future anywhere in the world.

This leads to the issue of the management of transboundary rivers. In 1975, a summer intern at the now-defunct Department of Technical Cooperation and Development of the United Nations did the first study in the UN Library to prepare an excellent Register of International Rivers. It was collecting dust in the shelf until it was spotted by Biswas (1999) and published in an earlier version of this journal. Aaron Wolf, a renowned expert in this field, and his colleagues have regularly updated this register. In the current issue of this journal, they have updated the list with better analyses and the latest data. This update confirms the magnitude and extent of the global problem with international rivers (McCracken & Wolf, 2019). In our view, this is a seminal work and a 'must read' for everyone involved with the management of transboundary rivers. We are very pleased that McCracken and Wolf have chosen this journal for its publication.

The rest of the papers in this issue include a state-of-the-art review of institutional arrangements for water governance (Hassenforder & Barone, 2018), a cost-benefit analysis of river restoration in Israel (Becker, Greenfeld, & Shamir, 2018), a study of the effectiveness of investments in irrigation modernization in Madhya Pradesh (Sinha, Gilmont, Hope, & Dadson, 2018) and several excellent analyses on groundwater: competing uses and stakeholder rights to groundwater in the Fuencaliente Aquifer (Berbel, Expósito, & Borrego-Marín, 2018); groundwater modelling of the Mancha Oriental Aquifer (Sanz et al., 2018); and an assessment of groundwater rejuvenation in Gujarat (Kumar & Perry, 2018).

All the papers of this issue are timely and thus should be of direct interest to our readers.

Disclosure statement

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Asit K. Biswas
University of Glasgow, UK; Water Management International Pte Ltd, Singapore; Third World Centre for Water Management, Mexico
http://orcid.org/0000-0001-9332-4298

Cecilia Tortajada
Institute of Water Policy, Lee Kuan Yew School of Public Policy, Singapore
cecilia.tortajada@gmail.com http://orcid.org/0000-0001-6308-4924