GLOBAL WATER SECURITY: AN INTRODUCTION AND OPPORTUNITIES FOR IAHR

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More information regarding Global Water Issues: https://sites.google.com/site/globalwatersecurity/

Introduction

In recent years there has been considerable growing international concern about the increasing crisis in global water security (see Figure 1), with security here referring to the supply of adequate water of sufficient quality for drinking, food production, ecosystem services etc. As an example of such a concern, in April 2010 the UK Royal Academy of Engineering published a report entitled Global Water Security – An Engineering Perspective [1]. This report was produced by three learned societies, through a Steering Group of 12 specialists working in the field. The Steering Group took evidence (in hearing and written) from a wide range of UK and international experts covering all aspects of water security. The report was commissioned by the Government's Chief Scientific Advisor, with the main drivers being concerns from various sources from within government, the professions and learned societies etc., about the increasing challenges arising relating to global water security and the implications for Britain, both within the UK and internationally. Some of these challenges, threats and opportunities are introduced below. There are approximately 1.2 billion people living on this earth today with no access to safe drinking water and it is estimated that 2 million people die annually of diarrhoea - still one of the biggest causes of infant mortality. I tell my first year students that it is water engineers that hold the key to reducing significantly this sad statistic, rather than the medical profession.

Other statistics reveal that there are 2.4 billion people who do not have basic water sanitation and up to 1 million die annually of hepatitis A. Women in developing countries have to walk typically 6 km daily to carry water for the family; again water engineers can make a huge contribution to the quality of life for these women. Floods often cause significant loss of life and destroy homes, with the August 2010 Pakistan floods leading to 20 million people being left homeless. However, the disease associated with

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the after effects of such floods can often bring far more loss of life to communities and countries than the floods themselves. It is reported that at any given time, half of the world's hospital beds are occupied by patients

Figure 1. Some recent publications on the topic of Global Water Security

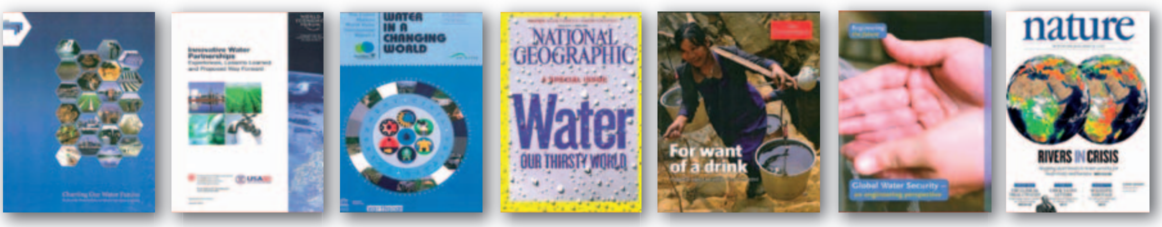
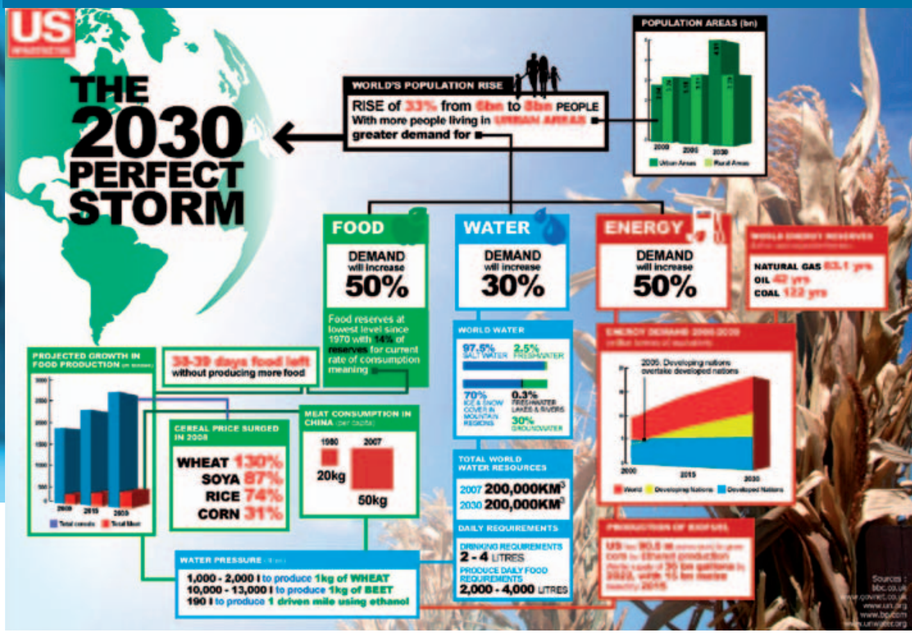


Figure 2: 'Perfect Storm' from a lecture by Professor Sir John Beddington



suffering from diseases associated with lack of access to safe drinking water, inadequate sanitation and poor hygiene. It is also worth noting that 70% of the world's fresh water supply is devoted to agriculture and over 50% of all water projects fail in the first few years after implementation. For further statistics see [2]. The challenges of water security are therefore considerable and are going to affect almost every nation on earth in one form or another – if not already, then certainly in the future.

Along with these challenges there are two further issues that are exacerbating the current threats to global water security. Firstly, there is climate change, where average global temperatures are expected to rise by at least 2˚C by the end of this century. If the temperature increases between 2 and 5˚C there will be major water resources problems globally, as well as significant sea level rise, causing catastrophic coastal flooding in many parts of the world, such as Bangladesh. Secondly, we are encountering 'the Perfect Storm' (as illustrated in Figure 2 from a lecture by Professor Sir John Beddington, UK Government Chief Scientific Advisor), in the form of global population growth by 2030 from currently 6.5 to 8 billion. Associated with this population growth we can expect the demand for food, energy and water to increase by 50%, 50% and 30% respectively. The water ⇨food⇨energy nexus is crucial to our existence, with water being at the heart of everything; it is crucial for our energy supply, food, health, industry, trade etc. If we look at the water stress globally (defined as millions of litres of water available per person per year) from 1960 to 2010, we find that even in the southeast of England water supply is currently particularly stressed. If we predict forward to the end of the century we see that even for a country like the UK, where it is perceived to be always raining, we will be facing water security problems across much of the country by the end of this century.

Problems in water supply will relate not only to the 50% increase in human population over the next 30 years; but urbanisation is occurring over much of the world and is tending to exacerbate this effect. In countries such as China, for example, people are moving into the major cities while in the UK people are moving more and more to the southeast of England; neither of these trends are sustainable in the long term.

Food production is also rising, along with industrial production, and new energy sources will be required to support this industrial production and feed the population growth. As countries become richer they will change their diets, as typified for example by the big increase in changing meat consumption in rapidly developing economies. If we now look at the consequences of changing diets and food consumption etc. in the context of embedded or virtual water, the global implications are considerable.

To produce 1kg of wheat requires 1,300 litres of water, whereas in contrast to produce 1 kg of beef requires typically 15,000 litres of water [3], i.e. over 10 times as much water. Looking at other commodities, it takes 140 litres of embedded water, nearly a bath full (150 litres), to produce one cup of coffee, and that water is used in another country - such as Brazil - when the coffee is drunk in Europe. One pair of cotton jeans requires 73 baths full of embedded water (see Figure 3), which are attributable mainly to the cotton production, and that water is likely to be used in countries such as Egypt, where there are already serious water shortages. The embedded water footprint of the 25 European Union countries bears most heavily on India and Pakistan, which are the primary sources of cotton supply to the EU. The drying up of the Aral Sea is one example which can be partly attributed to cotton production, though this is not the only cause of the drying up of this water body. The point to appreciate, however, is that the demand for embedded water products in one country can have very serious impacts elsewhere in the world, such as Egypt, for example.

Potential Solutions

Desalination is one possible solution in large coastal cities, but this process is still relatively expensive and imposes a large carbon footprint, through large energy demands. Research studies being undertaken within our Hydro-environmental Research Centre at Cardiff University have found that salinity levels along the Arabian coast of the Persian Gulf are increasing slowly, potentially due to the rapid growth in desalination plants and this must have long term impacts for the hydro-ecology of this highly stressed water body. However, Dr Paul Simon, a former member of the US Senate, writes in his book 'Tapped Out' that: "If we spent 5 percent as much each year on desalination research as we spend on weapons research, in a short time we could enrich the lives of all humanity far beyond anything anyone

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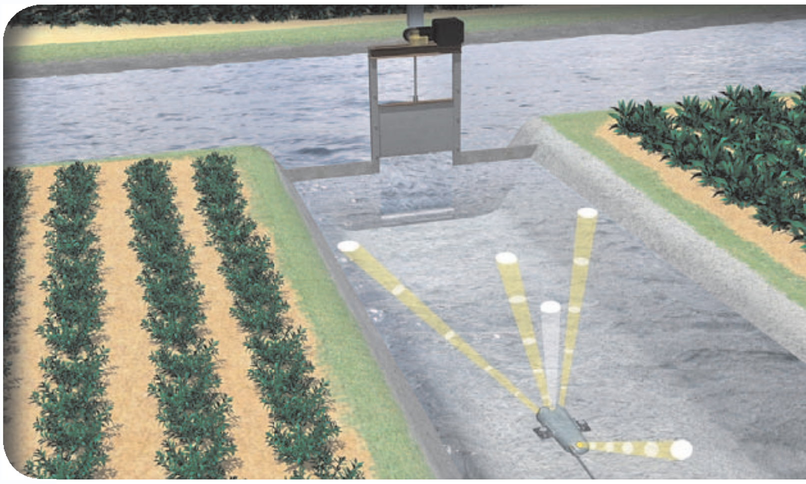
a: term used to express the superior intelligence in an acoustic Doppler measurement device;
b: a score on a standardized intelligence test determined by extraordinary data collection capabilities relative to the average performance of other flow meters.



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has conceived".

Conservation and water re-use is often a short term solution to a longer term problem. Storage involves water transfer and better integrated water management, with a much more holistic approach to river basin management being required than used hitherto. To increase global water security, improved water quality in river basins and coastal waters is required, along with a reduction in global water pollution. Many of our rivers today have very poor water quality

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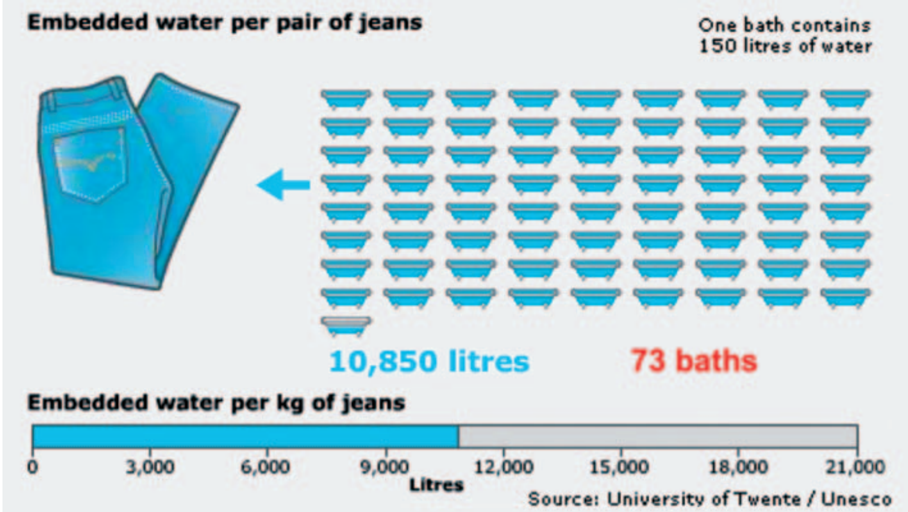
with 'the ancient Romans (having) better water quality than half the people alive now' [2]. It also goes without saying that global population growth needs controlling. Integrated water management requires a Cloud to Coast approach that treats the water cycle as an integrated system, bringing together the professionals who currently specialise in modelling various components of the system, including: hydraulic engineers, hydrologists, biologists etc. and with the distribution from the cloud to the coast, through the catchment, groundwater, sewers, rivers, estuaries, needing to be treated as one.

Figure 3: Concept of embedded or virtual water, where production of a pair of jeans requires 73 baths of water



Actions

In addressing some of these challenges global actions are needed; in particular, we need the water footprint and the concept of embedded or virtual water to be better understood and more widely promoted. Better technologies and further research are needed for more efficient agriculture. New sustainable sources of water are needed from desalination, recycling and water harvesting. Inter-governmental bodies, such as the World Trade Organisation, must elevate issues of water security further up their agenda. The public must become more engaged in the challenges we all face with regard to water security; this is a global problem which affects every nation.

Turning to the value of water, this poses the question: Is water a human right or is it an economic good? Economic theory informs us that it is easier to encourage funding if the true economic value of water is realised. Without it we get a price-cost differential and long-term sustainability becomes unlikely. However, to what extent is water a human right and, if so, whose responsibility is it to deliver it and meet the costs? True water pricing and trading is rare, but Australia and Chile have introduced it in their water scarce regions and they maintain that it has resulted in lower water consumption and significant increases in agricultural productivity. In the UK the average cost of water per cubic metre is £3 (≈$5), paid to the private water companies. This provides the consumer with approximately 1 week of water for drinking, washing, cooking, toilet flushing, car washing and in some places garden watering. This is not expensive in comparison with what else one could buy in the street for $5, including: a sandwich, two litres of bottled water, a Starbucks coffee, a glass of beer, etc. These comparisons place the price of water into context and one must question whether the cost of water is really so expensive that the price could not be raised in countries such as the UK? If we continue to undervalue this precious resource we will not be able to face some of the challenges that our world faces in the future [4].

IAHR Opportunities

In taking up some of the challenges and actions highlighted above, IAHR has already set up a task force to promote Global Water Security and has set up a website as a repository for reports, lecture notes and papers etc. on this topic.

Other actions that can be taken by IAHR could include the following:

- Establish links with engineering academies and other learned societies in key countries to collaborate to raise the profile of the water footprint.
- Develop links between the IAHR Divisions and key aspects of Global Water Security where IAHR has strengths, such as: desalination, turbulence, flooding, river hydraulics, groundwater, etc.
- Use Global Water security as a platform to develop closer ties with other kindred international water organisations, such as IAHS, IWRA, EWRI, IWA etc.
- Develop links with NGOs, and offer technical support to such organisations through our Technical Divisions, such as: WWF, FoE, Oxfam, UNICEF, Global Water Partnership.

References

1 Global Water Security - an engineering perspective (2010) available at: http://www.raeng.org.uk/news/publications/list/reports/Global_Water_Security_report.pdf
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3 Hoekstra, A. Y., Chapagain, A. K., Aldaya, M. M. and Mekonnen, M. M. 2011. The Water Footprint Assessment Manual. Earthscan Publishing, pp.201.